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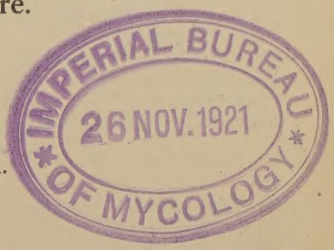

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DEVELOPMENT OF SWAMP LAND AT RUAKURA.

RECENT EXPERIENCE.

A. W. GREEN, Manager, Ruakura Farm of Instruction.

IT is now three years since the last article on the subject of swamp-land development at this station appeared in the *Journal* (January, 1918), and, as the methods then advocated have been further confirmed by practice, it is considered advisable to briefly review the system and place before readers the latest information. In the Waikato alone there are thousands of acres of unproductive peat-swamp lands of a similar nature to that at Ruakura, and the problem of development is practically identical.

No greater proof of the success of the methods advocated could be given than the excellent fields of rye-grass and clovers now to be seen at Ruakura, carrying their flocks and herds on what were only a short time ago waste areas of sorrel and rushes. Moreover, numbers of farmers after visiting Ruakura and seeing for themselves have adopted the same system on their own farms and secured good results.

Those who have had experience with peat-swamp land know that draining and stumping are not the most difficult propositions. To

VIEW ON THE SWAMP AREA AT RUAKURA, SHOWING STRONG GROWTH OF WESTERN WOLTHS RYE-GRASS.

This field was sown in March, 1918.

PART OF SAME FIELD, SHOWING GROWTH OF LOTUS MAJOR ESTABLISHED BY FEEDING OUT HAY CONTAINING LOTUS MAJOR SEED.

The Lotus major may be seen against the near front wheel of the car.

[*S. B. Taylor, photos.*

get anything useful to grow after this preliminary work is completed is undeniably the greatest problem. Sorrel takes possession, and repeated ploughing and cultivation only increases it. Proved sound methods in the development of this type of swamp land may be summarized as follows: (1) Reduce ploughing and cultivation to a minimum right from the commencement; (2) crowd out sorrel and swamp-weeds by sowing Western Wolths rye-grass in March; (3) consolidate and manure by heavy stocking, preferably with cattle; (4) maintain the stock on the rye-grass as long as possible by carting out feed during winter; (5) feed clover hay containing clover-seed, particularly white clover; (6) chain-harrow frequently; (7) surface-sow clovers and Lotus major during the following spring, and during November run the mower over the field to cut down sorrel seed-heads; (8) apply lime as a top-dressing and use alkaline manures.

It is presumed that the swamp has been drained, first by deep open drains and then by smaller lateral open drains. Field-tiles should not be laid until the land has been consolidated. It will then be found that after a good sole of clover and rye-grass is secured fewer under-drains will be required than was anticipated. The reason is that the pasture draws heavily on the moisture of the soil, and the land is thus to a great extent naturally drained. It has been estimated that the water passing through the leaves of clover by transpiration in the production of 2 tons of hay during the period of growth amounts to 504 tons per acre. This is equal to nearly 5 in. of rain.

Since the previous article appeared several experiments have been conducted at Ruakura in connection with the preparation of the land for establishing grass—from deep ploughing to harrowing. A study of the present pastures, which have resulted from these trials, will convince any practical farmer that deep ploughing of swamp land gives an excellent crop of sorrel, spurrey, swamp-rush, and cudweeds, and the first growth of grass will be Yorkshire fog. Sound advice is to keep the sweetened surface soil as near the top as possible during the first stages of development, taking advantage of this soil to promote the first growth of rye-grass.

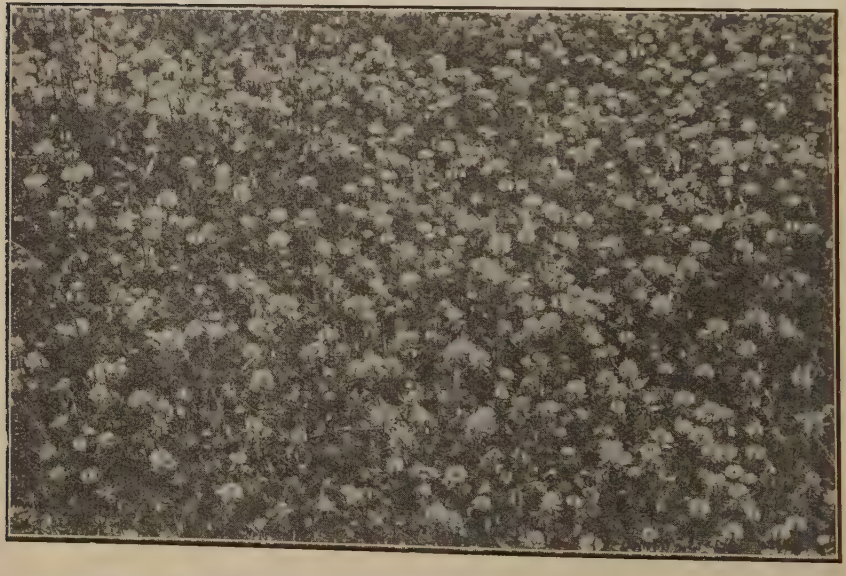
Western Wolths rye-grass has proved the most suitable grass for the first sowing, and should be seeded at the rate of 20 lb. per acre. If the land has been drained for some time and there is a hope of getting a take of red clover, 6 lb. of that seed per acre should be added.

The question has been asked, Why use Western Wolths rye-grass? The reply is that no other grass will make such rapid growth and thrive to the same extent. It forms a mat of surface roots and produces heavy leafage, crowding out and smothering weeds; it grows well into late autumn, providing the necessary feed for winter grazing; by its mass of fibrous roots it prevents the land poaching; it recovers quickly after stocking; it becomes firmly established the first autumn after sowing, and will consequently hold in check all spring weeds; its strong growth is lost after the first season, thus allowing a better take of clovers to follow; lastly, it is most palatable to all classes of stock, and they thrive well on it.

Several points in favour of a combination of Western Wolths rye-grass and red clover are worthy of mention, for in conducting the swamp-land experiments much care has been given to observation and

ANOTHER PART OF THE SAME SWAMP-AREA FIELD, SHOWING WHITE CLOVER ESTABLISHED BY FEEDING OUT HAY CONTAINING WHITE-CLOVER SEED.

[*S. B. Taylor, photo.*



A NEAR VIEW OF WHITE-CLOVER GROWTH ON PART OF THE DEVELOPED SWAMP AREA AT RUAKURA.

[*E. B. Levy, photo.*

investigation. It can be safely claimed that Yorkshire fog is considerably reduced by rye-grass and clover, and when the pasture is chain-harrowed frequently much of the fog is pulled out, whereas rye-grass and clover retain their roothold. Further, Western Wolths and red clover will crowd down red-shank, fat-hen, fireweed, and, in fact, most annual quick-growing weeds. It is the best temporary pasture mixture that we can recommend to clean up weedy land.

Consolidating and manuring by heavy stocking under correct methods are of vital importance in the breaking-in process, as described in the previous article. One must not think that cattle are placed on these areas and fed as though in yards. The rye-grass will provide good feed, but this should be supplemented by hay and roots. Should there be sufficient feed to carry a certain number of stock for, say, three weeks, the system of supplying supplementary feed will enable this stock to be maintained on the area for an extra two or three weeks without removal. The point is to retain the stock on the area as long as the pasture will provide clean feed, and to remove them immediately it becomes dirty. Then if the droppings are chain-harrowed without delay, in a month's time the field will be ready for restocking, but probably for a shorter period. It is interesting to note how rapidly the rye-grass recovers and springs into fresh growth again.

Most meadow hay contains white clover, and it will be observed that when red clover in a pasture is in full flower white clover is in seed. Then is the time to make the hay. Clover-seed passes through stock unharmed, and being fed to cattle during winter this is the method by which the white clover is spread from one area to another. The great advantage of establishing white clover on the poorer swamp areas cannot be effected in a cheaper and more economical manner, and it will perennialize the pasture. It has done so at Ruakura, where there are now many fields of excellent clover established under this method. Some of these have been down five years and are now among the best grazing-areas on the farm.

To win every acre of these unproductive areas by converting them into good pasture should be the aim of the farmer. The value of the swamp pastures with their great store of humus for many years to come is a great asset for our agriculture and the nation.

Sweet-potato Weevil (Cyclas formicarius).—This pest has been declared to be a disease within the meaning of the Orchard and Garden Diseases Act, and has been included in the Second Schedule of that statute.

Fruit-preserving Industry Act.—Societies registered under the Industrial and Provident Societies Act have been added to the category of organizations to which advances may be made by the Government for the purpose of erecting, equipping, or adding to fruit-preserving works (including cool stores).

THE BEET-SUGAR INDUSTRY.

CONSIDERATIONS FOR ITS ESTABLISHMENT IN NEW ZEALAND.

A. H. COCKAYNE, Biologist to the Department.*

THE cardinal factors of successful beet-sugar production appear to be three—namely, (1) an up-to-date manufacturing plant with the necessary labour and material for its optimum running, (2) an adequate daily supply of beets of comparatively high sugar-content to keep the factory at full capacity for approximately 100 days each year, and (3) a market value for refined sugar high enough to enable a price to be paid to the grower of beets which will yield him a per-acre profit in excess of what he can realize for any of his present major crops. The complete fulfilment of all these conditions would assure the establishment of a sugar-beet industry.

DISTRICTS SUITABLE FOR SUGAR-BEET PRODUCTION.

The sugar-beet requires a deep, well-drained, loamy soil; in general, soils on which mangolds can be successfully grown are suitable. An exception should be made with regard to heavy moist soils that are not particularly friable, as although sugar-beets may be grown on them the difficulties of ploughing up, removing the surplus earth from the beets, and cartage off the ground in the winter would greatly increase their cost of production. Intractable and thin soils should always be avoided. In point of fact, however, there are areas in nearly every part of New Zealand where the soil conditions are quite suitable. Climatic conditions are of perhaps greater importance than soil conditions, both in regard to a favourable sugar-content and ease of production and disposal. A comparatively dry period in the latter part of the growing-period and fine weather during the lifting of the crop are of special significance.

Apart from the factors of soil and climate, the type of farming commonly carried out in a district is fundamentally important in deciding in what districts sugar-beet-growing is capable of being developed. It may be laid down as an axiom that it is hopeless to attempt to establish a beet-sugar industry in any part of New Zealand other than where short-rotation pastures and rotation farming are predominant. It might be thought that the type of grassland of a district had nothing in common with successful beet-production, and it is perhaps necessary to explain the reason. In order to be successful financially a comparatively large acreage of beets within a few miles of the factory is essential. The only districts where this can possibly be secured are where the employment of short-rotation pastures render it necessary that a large portion of each farm should be ploughed

* When in Australia last year Mr. Cockayne visited the Maffra beet-sugar factory and investigated the industry generally.—EDITOR.

annually. Again, the district must be one where small rather than medium-sized or large holdings predominate. Where short-rotation pastures are not the rule the area of land likely to be cultivated per farm is generally so small as to render any successful beet establishment impossible without completely changing the farming practice, and this is not likely to be accomplished until at least beet-growing as the main crop of a farm has been proved to be more remunerative than any present type of soil-utilization.

From climatic or soil reasons Southland, South Otago, Westland, and North Auckland can be eliminated as potential beet-sugar districts. The fact that permanent or long-rotation pasture land predominates in the rest of the North Island makes sugar-beet production quite unnecessary for any part of the North Island. Of the rest of the arable land of New Zealand one has only Canterbury, North Otago, Central Otago, and parts of Marlborough and Nelson to consider. There is no doubt that on the better soils of the Waimea and Wairau Plains sugar-beets would do excellently from the soil and climatic standpoints, and the same statement applies to the deep, well-drained soils of Canterbury and North Otago. So far as Central Otago is concerned I consider that from many points of view the irrigation land of Ida Valley offers certain advantages far ahead of those of any other part of New Zealand.

It is thus seen that the districts here ranked as suitable for sugar-beet land correspond closely to the better-class wheat- and particularly barley-growing areas of the South Island. A class of land, in my opinion, splendidly adapted for sugar-beet-growing is such an area as that on the south bank of the Rakaia River, where during the past few years potatoes have been extensively grown. Much of the Southbridge, Leeston, and Ellesmere district is especially good, except those parts that are likely to lie wet in the winter. Again, the sandy loams of the Yaldhurst district seem to be excellently adapted for sugar-beet, and there are also large areas north of the Waimakariri where beets should do well. Personally, I consider that if an effort is to be made to persuade farmers to slightly modify their cropping programme and add sugar-beet to their other crops the main hope of success lies in what may be termed the Christchurch area, including the districts just mentioned. If, on the other hand, the effort is to be in the direction of forming special sugar-beet settlements where virtually no other crop is grown except for rotation pastures, then it does not matter very much where the attempt is made, provided the conditions of soil, climate, and haulage to the factory are suitable.

Some considerations may be here dealt with in regard to securing an adequate supply of beets for a factory in, say, the Ellesmere district, relying on the individual efforts of the farmers in the district rather than attempting the establishment of a definite sugar-beet settlement in order to start the industry. The average holding of the Ellesmere district is not less than 200 acres, and it does not appear to be feasible to get at most more than one-half of the farmers to risk the growing of a crop which is quite a new one to the district and which has the same reputation for labour requirement as has our mangold crop. Then, at the very most an average area of 20 acres for each grower appears to be rather an overestimate. It is generally

stated that in order to be successful the production of not less than 50,000 tons of beet is necessary for the proper running of a modern factory. (The Victorian undertaking at Maffra, however, has shown that less than 20,000 tons, even with an antiquated plant, would easily allow £2 per ton to be paid for beets, with refined sugar at £40 per ton—that is, under the conditions obtaining at Maffra.) If one allows an average yield of washed beets of 15 tons per acre, which is rather higher than is obtained on any non-irrigated sugar-beet area, then a minimum area of approximately 3,500 acres annually is necessary. This would mean that on the estimate given it might be possible to get 3,500 acres of beet grown over an approximate area of 70,000 acres, or, roughly, 100 square miles. This would mean that many of the crops would be grown at distances too far from the factory to make haulage attractive. The difficulty of the wide separation of the crops from the factory might be partly got over by growing them close to a railway station or siding, as has been done at Maffra, but the double handling necessary through railway transport would be a distinct disadvantage.

At Maffra an adequate supply of beets has never been attained, and in this instance only 22,000 tons was required to run the factory at capacity. Numerous reasons are given why they cannot secure an adequate tonnage, but the real one—namely, that only a small proportion of the farmers of the district are desirous of growing beets—is never stressed. If any company relied simply on the farmers of the district to grow the necessary beets it would almost certainly prove a failure in its first years, unless the price of sugar were enormously high and the price offered for beets much above that ever paid before.

It thus appears essential that some other means than merely erecting a factory and offering a certain price for beets be employed. The course open to success appears to lie in the company growing its own beets until such time as was demonstrated that the growing of the crop can be relied on in preference to any other. Even at Maffra, where sugar-beet-growing has paid the growers excellently in the majority of cases, it has not become universal, and on beet-growing land lucerne and maize appear to be crops that appeal to the farmer in preference. What is occurring at Maffra, however, is that many people who during the past few years have gained an insight into the growing and management of the crop by employment in the beet-fields are anxious to rent areas for the purpose of growing crops. In many cases they are quite unsuccessful in securing suitable land, or else are charged a rent in excess of the value of the land. It is this class of person that the Maffra manager particularly desires to encourage, and for that reason he stresses the necessity for a factory having control of a large area of ground that can be let to experienced growers, thus guaranteeing an adequate supply of beets. This idea is no doubt quite sound so far as Maffra is concerned, where the crop has been grown for over a decade. In New Zealand, however, if a company had blocks of land to rent it may be doubted if any one would take them for sugar-beet-growing. This only emphasizes the opinion that in the early years of establishment the major supply of beets must be grown by the factory. Later on, when once the success of the enterprise had been established, without doubt the land could be rented to their employees. The main

objection to the factory having a large block of ground is that beets cannot be grown continuously on the same land, and the company would find itself in the position of having to carry out diversified farming with its many pitfalls.

THE GROWING OF SUGAR-BEET.

For all practical purposes the growing of sugar-beets can be considered to be almost identical with that of mangolds, excepting that the rows can be closer, and must on no account be ridged, as is sometimes the case with mangolds. Owing largely to the fact that unless really properly attended to a mangold crop is generally a failure, mangold-growing has never become popular in New Zealand, less than 10,000 acres being grown throughout the Dominion. The main mangold-growing districts are Canterbury and North Otago, where about 40 per cent. of the total crop is grown. As Canterbury also produces over half the total of potatoes—a crop requiring somewhat similar attention to the sugar-beet—these facts again emphasize the point that sugar-beet-growing is more likely to become established in Canterbury than in any other part of New Zealand.

The sugar-beet, apart from thinning and weeding, must be intertilled. This, combined with the necessity for deep cultivation prior to sowing and the deep-rooting nature of the crop, makes it suitable for districts where the rainfall is comparatively low, as in Canterbury. At Maffra one of the main reasons brought forward to explain the rather poor response that has been secured for the production of beets is that the climate is too dry, and that this will not be remedied until irrigation becomes general. Now, the rainfall at Maffra is not high, the maximum yearly average for ten years being 21 in., which is not so very different from the Lincoln figures in Canterbury. The point as to whether Canterbury is rather too dry has been discussed with many of those interested, but my opinion is that the advantages of a comparatively dry climate outweigh the disadvantages of small yields in seasons of low precipitation. I am inclined to think that even at Maffra, apart from certain seasons when the rainfall was considerably less than 20 in., the dryness of the climate, enabling the crop to be easily intercultivated, lifted, and carted from the fields, has been of distinct advantage.

In the growing of sugar-beet hand-labour could easily become excessive, and proper machinery for drilling, intercultivating, and lifting the roots is essential.

COST OF PRODUCING SUGAR-BEET.

It is difficult to estimate the exact cost of growing beets in New Zealand, as all experimental work in this connection has been conducted on areas too limited to supply satisfactory figures. Nevertheless, from the Victorian experience, coupled with the knowledge of the cost of growing such a crop as mangolds, a very fair idea can be formed. The following statement rather over- than under-estimates so far as present prices are concerned. It has to be remembered, however, that it is held in certain quarters that except in some instances farm labour in New Zealand has not yet kept march with the falling value of money, and that further increases can be expected: Rent or

interest (land £50 per acre), £3; cultivation expenses prior to seeding, £2; seeding, drilling, and manuring, £1 15s.; cultivation expenses after seeding, £3 5s.: total, £10.

This brings the cost to £10 per acre irrespective of what may be the yield per acre. In addition there are topping and cartage charges, which may be put down at 9s. per ton, provided cartage does not exceed three or four miles. From these figures the following table is deduced:—

Cost of Crop delivered to Factory.

	Per Acre.			Per Ton.		
	£	s.	d.	£	s.	d.
A crop of 10 tons costs	14	10	0	1	9	0
,, 11 ,, ...	15	6	0	1	7	10
,, 12 ,, ...	15	8	0	1	5	8
,, 13 ,, ...	15	17	0	1	4	5
,, 14 ,, ...	16	6	0	1	3	3
,, 15 ,, ...	16	15	0	1	2	4
,, 16 ,, ...	17	4	0	1	1	6
,, 17 ,, ...	17	13	0	1	0	9
,, 18 ,, ...	18	2	0	1	0	1
,, 19 ,, ...	18	11	0	0	19	6
,, 20 ,, ...	19	0	0	0	19	0
,, 21 ,, ...	19	7	0	0	18	5
,, 22 ,, ...	19	18	0	0	18	1
,, 23 ,, ...	20	6	0	0	17	8
,, 24 ,, ...	20	16	0	0	17	4

It may be considered that an average of 10 tons per acre can be looked upon as a minimum even during unfavourable seasons, and our experiments indicate that 24 tons is the maximum yield that one can expect. In general, it appears as if sugar-beet yields about 40 per cent. the weight per acre of the mangold crop in New Zealand. This would indicate that yields of as high as 40 tons might occur in extremely rare instances, but in such cases the sugar-content would seriously fall and make the manufacturing charges excessive. Out of a number of small trials held in different years 14 tons per acre has been the lowest yield and 24 tons the maximum. Even in the case of the high tonnage the sugar-content and purity were satisfactory. These trials, however, are likely to be above the yield obtained when the crop is subjected to ordinary field conditions, and their probable error is too great for any definite conclusions to be based on them. An estimated average yield of 15 tons of washed beets is perhaps a little on the high side, but recent Ashburton experience would indicate that such a figure is not excessive.

From the figures given a 15-ton crop would cost £1 2s. 4d. per ton delivered to the factory, giving at a price of £2 per ton a profit of approximately £13 per acre. When this is compared with other crops against which sugar-beet is in competition the comparison is certainly in favour of the beets. The figures for production here given would, however, be quite likely to be exceeded during the first season or so, owing to unsuitable machinery and the dearness of inexperienced labour. Still, from the cost-of-production point of view alone beets at £2 per ton would probably in favoured districts yield a greater per-

acre profit than any of our staple farm crops. It will be noticed that the price to be paid is based at £2 per ton irrespective of what the sugar-content may be. The Maffra payments are made on tonnage and not sugar-content, and this system would naturally be followed in New Zealand. The sugar-content of New-Zealand-grown beets is not dealt with, as the analyses already made indicate that in this respect they are quite as satisfactory for manufacturing purposes as have been the Victorian crops. The figure £2 per ton has been taken partly because a Canterbury concern purposes such a rate of payment, and partly because it is the present price at Maffra, although there is every reason to consider that at a price of over £40 per ton for refined sugar the price paid for Victorian beet should be higher.

THE MANUFACTURE OF BEET-SUGAR.

So far as the manufacturing end of the business is concerned, this is a matter for an expert, but certain phases can be discussed with a fair amount of accuracy. It is currently stated that an up-to-date factory capable of dealing with 500 tons of beets per day during the running-period is essential, and that smaller plants through their less economical running should not be admitted. The contention is that smaller units when tried in America have had to be scrapped and replaced by larger ones. One could well understand the soundness of such reasoning if it could be proved beyond doubt that once a 500-ton per-day plant was erected in New Zealand the requisite 50,000 tons or more of beets would be available. As already indicated, the Maffra plant, although small, has never yet had a sufficient supply of beets to keep it at full capacity during the season. If the contention that it would be found impossible to get the farmers of any New Zealand district to grow within the first year, or even longer, anything like 50,000 tons of beet is correct, the advantage of having a factory capable of handling far more beets than can possibly be supplied to it is not apparent. If a 500-ton factory is essential (personally, I do not think it is, because at £40 per ton for refined sugar the Maffra factory, dealing with about 13,000 tons of beets, last year showed a profit of over £16,000), then it becomes more than ever necessary that the factory should itself produce the major quantity of the beets required. It would perhaps be possible by expert propaganda and liberal advances for production-expenses to get, say, 1,000 acres sown to beets in the initial season, but to expect more seems to be unduly optimistic. The question as to whether a 50,000-ton factory can be made to pay on a 10,000-ton supply is a matter that requires strict investigation. If it is shown that it will not do so, then no reason for the advocacy of a plant of such dimensions is apparent.

So far as the various incidentals necessary to manufacture—such as machinery, coal, water, and limestone rock—are concerned, there seems no reason why any of these should prove limiting factors in New Zealand. In many of these particulars Maffra is by no means ideally situated, and had a full-capacity load of beets been available since the commencement of operations the venture would have been an assured success from the start.

The location of the factory is extremely important. It should be as near the centre of production as possible, and the necessity for it to be on a railway-line is obvious.

CAPITAL REQUIRED.

For a 50,000-ton factory the following approximate capital would be necessary: Plant, £220,000; working-expenses at £1 15s. per ton of beets handled (working capital), £87,500; 50,000 tons beets at £2, £100,000: total, £407,500.

Allowing 10 per cent. depreciation on plant and 6 per cent. return on all capital invested, the cost of treating 50,000 tons of beets would be approximately £234,000. Allowing 6,000 tons of sugar as being a fair return from 50,000 tons of beet, with sugar at £40 per ton, there would be a profit of £6,000. There would also be additional profit from molasses and other by-products, but these sources of revenue might be expected to be small in the early years of development. It may be that the foregoing estimate of plant is high, and working-expenses are put down at 15s. per ton more than they were at Maffra in 1916–17. It is, however, well to overestimate, and if a profit can be shown the chance of success from the manufacturing end is then certain.

Using the same plant for a 10,000-ton crop we get the following figures: Cost of plant, £220,000; manufacturing at £1 15s. (working capital), £17,250; beets at £2, £20,000: total, £247,250. Depreciation, working-expenses, and interest on capital per year would amount to approximately £74,000, and the sugar return, at £40 per ton, would be £48,000, leaving a loss of £26,000. It can be thus seen that on a 10,000-ton basis, in order to make the enterprise show a 6-per-cent. return on the capital invested, and without taking into consideration any taxation, it would be necessary that the plant cost less than £70,000. Should the price of refined sugar fall below £40 per ton, unless caused by overproduction, it would be a clear indication that the value of money was rising, and in consequence the apparent cost of manufacture would drop in sympathy, so that the industry should pay just as well at £30 a ton or less as it would now at £40, always assuming that the figures stated are correct.

With sugar at £40 per ton £39,000 profit could be made by the grower off 3,000 acres, a fair return obtained on capital invested for manufacture, and over £70,000 distributed in wages and salaries. The great monetary return per acre and the large amount of capital and labour that can be sustained put beet-sugar production on an unique basis, and certainly warrant every consideration being given to the subject, and to any soundly based project.

Dairy Registration.—The annual fee for the registration of dairies supplying milk for domestic consumption in towns and cities has been increased from 5s. to 10s.

Peas for Lamb-fattening.—The best time to turn lambs on to peas is when the first pods are full. As the crop ripens the lambs become accustomed to the hard peas, and later will pick them from the ground when quite ripe.—*T. W. L.*

GRASSING OF BEECH-BUSH HILL COUNTRY.

EXPERIMENTS IN THE MURCHISON DISTRICT.

C. S. DALGLIESH, Fields Instructor.

THE grassing of beech-bush hill country in the Murchison district (Nelson back-country) has been a great source of trouble to the settlers, as the grasses sown last for three or four years only, and then bracken-fern completely takes possession. After the first two or three years the grass-growth is generally too scanty to allow the heavy stocking of the ground when the fern is coming away in the early summer, so that unless a sward can be secured which in itself will serve as an efficient competitor for the occupation of the ground fern is certain to become dominant in a few years.

Where the settler has a considerable area of flat country capable of growing good permanent and temporary pastures he is in the position of dealing with a considerable amount of hill country through his ability, whenever occasion demands, to heavily stock burns that are running into fern, and to recuperate his sheep after they have been kept under less than maintenance conditions on the hill country. In general, however, the owner of good flat ground leaves severely alone his hill-bush country, while the holder of only hill country, by means of burning and sowing down fresh areas, keeps his pasture-supply going until he has dealt with all his area, by which time many of his earlier burns have run into fern, and the ruin of his whole holding is often only a matter of a few years.

From the foregoing it can be seen that the grassing of certain hill country in the Murchison district should not be attempted on a large scale until such time as there is reliable information regarding what kinds of grasses are best to sow and what method of management is best to adopt. The good growth for the first two years that is secured by reason of the temporary fertility of the soil due to the ashes formed through burning off the forest has in the past misled settlers as to the capabilities of the ground in supporting even a fair type of permanent pasture.

The soil of the Murchison hill country in general, as its original plant covering would indicate, is very deficient in lime, and also shows a marked deficiency in phosphates. Whether liming and the application of phosphates is in any way practicable is extremely problematical, but experiments in this direction are much to be desired.

The experience of the settlers has shown that Chewings fescue is by far the most promising of the permanent grasses to sow, but it has rather a bad name owing to its not being relished by stock when the herbage is old. The value of Chewings fescue, however, is undoubted, and especially so on such country as the Murchison hills, where the rainfall is sufficient to keep it growing during a good part of the year. As in other similar country in New Zealand, Danthonia pilosa makes a great effort in certain places to compete with fern in the final

possession of the ground, but in general except on dry sunny faces where the fern is not very vigorous it does not appear to establish readily, and when sown along with the original seedings has often proved very disappointing. Another factor that has a most serious effect on the permanent establishment of grassland is the great prevalence of grass-grubs in certain seasons, both the ordinary grass-grub (*Odontria zealandica*) and the green chafer (*Pyronota festiva*) causing great destruction.

THE GRASSING EXPERIMENTS.

In the spring of 1916 a typical area of 15 acres of this class of country in the Matari Valley, owned by Mr. J. Badcock, was felled, and was burnt in the autumn of 1917. It was then sown down in five grass-mixtures by the Department, with the object of ascertaining what type of grassland might best be produced. The main constituents of the mixtures were cocksfoot, Chewings fescue, fiorin, Poa pratensis, crested dogstail, Yorkshire fog, Danthonia pilosa, and yarrow. A very successful take of the grasses was secured, and excellent growth resulted the first year, the area being only lightly stocked. Since then stocking with sheep has been carried out under similar conditions to those on adjoining lands. With the exception of the portion on which a mixture of fog and Danthonia was sown, the pasture on the area, although not first-rate, is better and healthier in appearance than that of similar surrounding lands, and is improving, a marked improvement having been noticeable in the last twelve months. Fern is not yet causing trouble, only isolated plants being found. This can be attributed partly to the successful burn secured, also to the area being closely grazed. Stock have always shown a preference for grazing on this area, being at all times allowed access to it when put on adjoining lands.

Chewings fescue, fiorin, Poa pratensis, and yarrow have combined to form a very good pasture for this class of country over the greater part of the area. The following notes regarding these and some of the other grasses sown on the area afford useful points :—

Fiorin : This grass has a strong hold on the shady sides of spurs, but is not so prominent on the sunny sides. It has been allowed to go to seed freely where it predominates, but where combined with other grasses it is more closely fed down. It is considerably later in spring growth than other grasses.

Cocksfoot : This has not shown to advantage, and is only moderately fair where liberally seeded. It would appear as if cocksfoot is quite unsuitable for use on this class of country. Even when it becomes established its superior palatability causes it to be overgrazed—even when the ground as a whole is lightly stocked. On this class of ground, unless a highly palatable grass can become dominant, it would appear better to confine the sowings to grasses of medium palatability rather than aim at a proportion of highly palatable grasses that can be killed out readily by overgrazing, such as is the case with cocksfoot.

Poa pratensis : Although slow to start, this grass is now making good headway, and is at its best on the sunny sides of the spurs. On the rocky points of spurs and on sidlings which have a loose surface it forms a binding turf which prevents the loose surface from shifting so readily. Stock have always shown a decided preference to graze on the area on which it is dominant, and during the first season they

had to be removed from the whole area, due to their keeping the Poa pratensis plot too closely fed down. There is every indication that Poa pratensis, although theoretically only suited to soils fairly well provided with lime, is one of the most valuable grasses for the Murchison district.

Chewings fescue: This has done well both on hill-faces and lower lands.

Crested dogstail: This is only sparsely distributed through the hill-faces, but in moist places where the land is inclined to be heavy it has a strong hold, forms a close sole, and is to be found closely fed down.

Yarrow: This plant is freely distributed over all the area, and is kept closely fed down, forming a compact turf in combination with the grasses.

Danthonia pilosa: The seedings with this grass have been more or less unsatisfactory, although when sown in combination with fog its resistance to the attacks of grass-grub was most marked, the fog being completely destroyed and isolated plants of Danthonia alone remaining. Could it be established rapidly Danthonia would certainly prove valuable, but the difficulty of sowing and the high cost of the seed would always be a drawback. Sowing down small areas on the flat ground, allowing the grass to seed, and then stocking with sheep which would carry the seed in their fleeces on to the hill country, according to the practice adopted in certain parts of New Zealand, seems perhaps the only way of inexpensively introducing Danthonia into these pastures.

CONCLUSION.

The future of these experimental seedings will be of great interest, and their development will be watched carefully. At the present time it is fairly safe to say that rye-grass and cocksfoot should be eliminated from mixtures used on such country, and that a combination of Chewings fescue, fiorin, Poa pratensis, yarrow, and perhaps crested dogstail is likely to provide quite fair permanent grassland. It is particularly to be regretted that the sowings did not include tall fescue, a grass that in certain poor hill country is giving promise of being the most valuable dominant grass that should be sown. The great weakness of a combination of the grasses mentioned is the absence of clovers, but the soil with its present deficiency in lime and phosphates does not give any immediate promise of the successful establishment of permanent clovers.

Balled Red-clover Seed. — An interesting specimen of red-clover seed, in which masses of the seed were balled together with some syrupy matter, was submitted recently to the Chemistry Section for examination. The substance dissolved in water, and reduced Fehling's solution without previous inversion. It now appears from information received by the Department's Biologist while in America that the phenomenon is well known there, and is caused by an aphis (*Aphis Bakeri*).

PIG-BREEDING.

SELECTION AND MANAGEMENT OF THE BOAR AND SOW.

K. W. GORRINGE, Instructor in Swine Husbandry.

THE BOAR.

THE choice of the boar is one of the most important matters in the successful breeding and rearing of pigs. It is true that with pigs a false step can be more readily retraced than with other farm-animals, such as horses and cattle, owing to the shorter period of reproduction, but this does not lessen the necessity for the greatest care being taken when starting a herd of pigs, or when purchasing a boar for use in an established herd.

The type of boar to be sought for is one compact in frame, as long and deep in carcase as possible consistent with strength, with a wide, deep capacious chest, legs placed well outside the body, well developed in the hind quarters, ribs well sprung, with deep flank, medium-sized ears, wide between eyes, bone of good quality, standing well upon his feet, good action, and showing strong masculine qualities. Both testicles should be visible and evenly suspended in the scrotum. The embryo teats should not be less than twelve in number, evenly placed, and distinct in development. Further, he should be from a good family showing prepotency, prolificness, constitution, and early maturity.

The selection should be made preferably from a breeder of repute whose stock has stood the test. The safest course is to visit the herd of the breeder and buy after seeing the sire and dam, and, if possible, others of the same strain as the animal selected. In making the final choice preference should be given to a boar from a large even litter, as fecundity is hereditary. The power to produce good litters is an essential in successful pig-breeding, and a good even litter is the best indication one can have. A special qualification is the possession of a gentle, docile, and tractable disposition. A bad temper is almost invariably transmitted.

It is not easy to judge a young boar just weaned. The powers of the digestive functions are practically unknown at that period, and until these are more developed it is difficult to arrive at a safe conclusion. His disposition, ability to put on flesh, and capacity for stock-getting can be estimated only after the birth of his first litter. It is therefore inadvisable for the inexperienced breeder to purchase a boar under six to eight months old. Many breeders, of course, purchase boars when weaners, but to be successful in this way requires a wide experience and sound judgment. It is much safer for a beginner to buy a mature boar than a young untried one.

Some breeders of purebred stock have in the past been too willing to sell for breeding purposes the bad with the good, and amateurs, without knowing better, have used boars which have nothing to recommend them but their pedigree. When allied to quality and size pedigree possesses considerable value, and is more or less of a guarantee

that the produce will be good, but it confers no advantage on a boar with nothing else to recommend him.

It is a great deal better to own a good boar in partnership with one's nearest neighbour, or to have one to be used co-operatively among a certain number, than each to have an inferior animal, which practically means a backward movement in the type of each herd.

The management of the boar is a very important part in the raising of strong, healthy pigs, and one which is sometimes neglected. He should be looked upon as the most valuable animal in the herd, and as such deserves the best of attention. A boar for service should never be fat. In some cases breeding-power is injured by too high condition at some time in the life of the animal. He should be well fed, but not fat, as this has a tendency to make him inactive, a slow breeder, and an uncertain sire.

The young boar should not be put to service until he is at least six months old, or, better still, eight months, and then only to a small number of sows at first. Too much work at this age may permanently ruin him. It should be remembered that one good service is all that is necessary, and it behoves the breeder to conserve the vitality in his boar as much as possible.

During the breeding season it is well to confine the boar to his paddock. As soon as the sows come into heat they can be brought into the boar's pen for service. This is a much better plan than allowing the boar to run with the sows, as a more accurate record can be kept of the time when they will farrow, or come on again in heat. It is during the breeding season that the boar may become unruly, often showing temper, and he should not be trusted too much when attending to him. If it is necessary to chastise him, never use a heavy weapon, or severe injury may be caused. A light stick or cane, giving a smart rap on the snout, is all that is required to keep him in order.

A boar well fed and cared for may be expected to keep in serviceable condition until he is ten years old, although many boars prove prolific and virile long after that age.

The ration of the boar during the breeding season should be abundant. The only index to the amount of feed to be given is his condition, and this should be evenly maintained, if possible, throughout the season. The following feeds provide a suitable assortment: Skim-milk, buttermilk, lucerne, peas, beans, clovers, millets, maize, rape, roots, and other foods in which the necessary elements are prominent. Food should be given at regular intervals and at least twice a day.

The matter of cleanliness should never be overlooked. Pay special attention to the feeding-trough and receptacles for holding the food. Look to the comfort of the boar by supplying good housing, and proper sanitation in his run, plenty of fresh water, and as much exercise as he will take. Under such conditions little trouble should be experienced in getting a boar to produce large litters of strong, healthy pigs.

THE SOW.

The selection of the sow for breeding purposes, whether it be for raising porkers, baconers, or stud stock, demands careful study and good judgment; but it is not essential, as in the case of the boar,

that she be purebred (unless stud pigs be the object) if she is suitable in other respects. It is, however, of great importance to ascertain that she is the progeny of quiet and good-tempered parents, for an irritable, restless sow is frequently the source of disaster at farrowing-time; that she comes from a good milking-strain; and that she is possessed of at least twelve well-developed teats, regularly placed, and extending well forward along the body.

The points and characteristics to be sought for in a sow are early maturity, length and depth of frame, broad and well-let-down hams, and well-formed udders; she should be compact, tough, roomy, with a good girth, straight back, broad loins, standing on good short legs with bone of fine quality, and plenty of good silky hair. She should have a good docile temperament, kindly disposition, and be cleanly in habit. She should come from a family of uniformly good mothers and large litters. Spring litters are to be preferred, because the young sows will as a rule grow and develop better during the summer than the winter, and with proper management they can be put to the boar so as to farrow at about twelve months of age.

As to disposition, the sow should be, above all, motherly, quiet, gentle, and kind. It is as well to reject any that have a tendency to fatten, for a big clumsy sow is unprofitable and disheartening. The same can be said of a fidgety ill-tempered sow; she is not a success in rearing a litter. Sows coming from mature mothers are usually the best breeders. The principle of the milking-strain in a cow applies equally to the sow. It is therefore advisable that this characteristic be preserved, and breeding-stock should be selected from sows which have heavy-milking qualities, for upon this depends the welfare of the progeny.

The young sow should not be less than eight months old before being sent to the boar. If maternity be forced on her under this age it may result in small litters and immature stock, and in many cases it has been the means of permanent injury to the animal. A young sow will show evidence of sexual heat as early as five months. Her pigs are seldom so numerous as those of a mature sow, and they are never so large. If a gilt is used for breeding and her litters are weighed at birth, it will be found that they are lighter than the pigs of a litter produced by a mature sow. In the matter of size the litter follows the dam. No attempt should be made to obtain large pigs from a small sow by using a large boar.

A breeder whose aim is success should not buy or retain a sow which does not comply with the standards set down, and it is better for the amateur to purchase a mature sow with a record than a gilt, however near the latter may be to farrowing.

It may not be always suitable to breed from purebred sows, but for the production of pork the purer the herd the better the results. Good sows from the original Berkshire and Yorkshire breeds are inclined to be a little coarse in character compared with the improved types, but they are prolific, hardy, good mothers, and are noted for converting their food into rich milk.

GENERAL.

In making the selection of either a boar or sow it is of practical importance to recognize two types, which may be called the "pork" and the "bacon" types. Farmers will be guided to some extent by

the requirements of the trade they intend catering for. Skill and judgment should be brought to bear in the matter of mating. When possible select an animal with an extra degree of good qualities that are deficient in the other, so that these may be balanced in the progeny. At best it is almost impossible to choose sows that will always reproduce true to type, but by careful selection of both boar and sow the chances of uniformity will be greatly increased. Some mistakes are bound to be made, but by keeping records of the breeding-stock and their produce it will be possible to dispose of undesirable animals. One ideal of type must always be uppermost in the breeder's mind, and in order to make real progress the stock must be constantly approaching nearer and nearer that ideal.

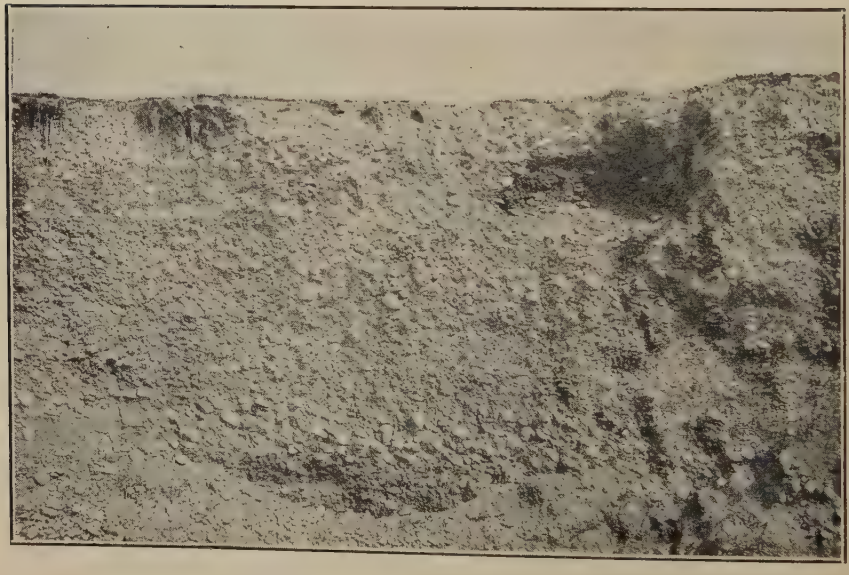
DRY FARMING.

R. McGILLIVRAY, Fields Instructor, Christchurch.

THE fundamental principles of what is termed "dry farming" or "dry culture" concern the storage in the soil of the annual rainfall, its retention there until required, the prevention of direct evaporation, the choice of plants suitable to arid conditions, and the sowing of drought-resisting strains. Dry farming may be further defined as the intensive cultivation of the soil in country of scanty rainfall to conserve moisture. It is not farming without moisture, but saving and making the utmost use of what rain does fall.

Aridity is a condition met with in parts of almost all countries; dry farming is therefore a world-wide problem. Its objects are the profitable production of useful crops without irrigation on lands which receive a rainfall of, say, less than 20 in. per annum, but its methods may be profitably employed where the rainfall is much in excess of that mentioned. In dry regions the conservation of natural moisture for crop-production is of paramount importance, as under such circumstances water is the limiting factor. In Australia there are immense areas that can only be brought under production by dry farming, while in the United States of America there is estimated to be over 1,000,000 square miles, or about ten times the size of New Zealand, that cannot be irrigated, and so must be reclaimed by dry culture. Extensive tracts of country of a similar nature are to be found in Africa, Asia, South America, and also in Europe. More than one-half of the land surface of the globe receives a rainfall of less than 20 in. per annum, and about one-quarter 10 in. or less per annum. It has been estimated that a perfected system of irrigation could affect only about one-tenth of these vast areas, and the reclamation of the remaining nine-tenths could not be done except by dry farming. Where irrigation is impossible dry farming is thus the only key to the settlement of dry country, and as such should receive the cordial support of all those interested in closer settlement. If conditions are suitable and the work is systematically performed, dry culture cannot fail, for the practice is based on thorough tillage—the supreme principle of successful agriculture.

A DEEP SANDY LOAM, SUITABLE FOR DRY FARMING.



A GRAVELLY SOIL FORMATION, NOT WELL ADAPTED FOR DRY FARMING.

[*Photos by B. M. Davis.*

Although there is good evidence that the ancients practised the art of dry culture in various parts of the Old World, it is only in comparatively recent times that the modern agriculturist has given attention to the work. The celebrated agriculturist, Jethro Tull, born in 1674, was the pioneer British dry-farmer. His methods of soil-tillage lie at the foundation of the modern system of dry culture. The honour of having brought prominently to the front the present dry-farm agriculture of the Western World belongs to the people of Utah. In 1847 the pioneers entered Great Salt Lake Valley, and inquiring minds set to work to find out how to grow crops without irrigation. Experiments proved that the project was a feasible one, and from that time on the practice has grown and prospered.

DRY-CULTURE METHODS.

The soil mulch and its management is perhaps the most important point in dry farming. By a "soil mulch" is meant a loose layer of soil of varying depth on the surface of the field, produced by means of cultivation for the purpose of breaking capillary action and so preventing the escape of moisture. The mulch should be renewed as often as required, and its renewal is imperative after every fall of rain. The dry-farmer must beware of weeds. They have no place in dry culture. They are moisture-thieves, and a weedy dry farm, irrespective of soil or situation, is doomed to failure. The fertility of the soil must be maintained by the application of farmyard manure and litter, or the occasional ploughing-under of a leguminous crop. In a soil of high fertility, plants will attain maturity with a minimum supply of water.

Sowing the seed is an operation that in point of importance is comparable to efficient ploughing and the maintenance of the soil mulch. Broadcasting of seed is quite foreign to the principles of dry farming. The dry-farmer must have control of his soil, and must place the seed at a sufficient depth to enable it to come in contact with moisture. All seed must be sown through the seed-drill, and it must be borne in mind that the amount of seed required in dry culture is about one-half of that required under humid conditions of agriculture. Wheat has from earliest times been the staple crop in arid regions, but oats, rye, and barley are all now grown successfully Lucerne has proved its worth under dry culture, and potatoes are now known to respond well, and under such conditions are of high quality.

The quantity of water required by plants in dry regions is about one-half more than in humid climates, and the dry-farmer should ascertain the average annual rainfall over the area he intends to farm. Meteorological records are of importance to all farmers, but to the dry-farmer their importance is enhanced. He should also be closely acquainted with his soil and subsoil, so as to know exactly what treatment to adopt to conserve the precious moisture. Deep sandy loams or silty soils well supplied with organic matter are the best for dry-farming practice. Investigations in Utah proved that under a good system of culture it was possible to conserve 95 per cent. of the total precipitation for plant-use. Deep ploughing and the thorough pulverization of the soil, to be followed by rolling and then cultivating

LAND IN NATIVE STATE ON TERRACE ORCHARD COMPANY'S PROPERTY, ALEXANDRA, NOW UTILIZED FOR CROPPING.

The white patches are scab-weed (*Raoulia lutescens*).

STACK OF GARTON OATS GROWN ON TERRACE ORCHARD COMPANY'S LAND.

The crop was sown in April and harvested in December, the area of 15 acres averaging 2 tons of oaten chaff per acre.

[*Photos from Report of Southern Pastoral Lands Commission, 1920.*

to form a surface-soil mulch, are factors which if attended to will enable suitable soil to hold the maximum amount of moisture. The depth of the mulch is important. Investigations have shown that cultivation to form a soil mulch 4 in. deep reduced evaporation by 72 per cent., cultivation 8 in. deep reduced it by 88 per cent., while a mulch 10 in. deep almost wholly stayed the loss of moisture.

The watchword of the dry-farmer should be "Cultivation." The development of dry culture is teaching the old but too-often-forgotten lesson of the value of good tillage and the intercultivation of growing crops.

SOME NEW ZEALAND EXPERIENCE IN DRY FARMING.

Extensive areas in New Zealand could be profitably farmed under dry-culture methods. Our rainfall varies from about 11 in. in parts of Central Otago up to about 120 in. in some other parts of the Dominion. A considerable portion of the South Island ranges within the 20–30 in. rainfall, and where soil conditions are at all favourable dry culture would render crop-failures under such a rainfall an impossibility. Dry farming is only in its infancy in the Dominion, but examples of its successful practice may be cited.

Considerable interest has been aroused by the dry farming carried on at the Terrace Orchard Company's property, of some 800 acres, at Alexandra by the manager, Mr. G. H. Barker. As already indicated, Central Otago has a climate of exceptional dryness, while the summer temperature is high. The average number of days per annum on which rain falls may be set down as about sixty. The rainfall for the twelve months ended 31st December last amounted to only about 12 in. Yet on the Terrace property, under such circumstances, remarkable results have been obtained, despite the fact that the land is not eminently adapted for dry culture. The accompanying photographs indicate the evolution of a part of the property from the extremity of depletion to a condition enabling the production of a crop of oats returning 2 tons of chaff per acre. Last season an acre of wheat on this property yielded 60 bushels, and onions gave a most profitable return. Fruit-trees are also flourishing. The experience at the Terrace Orchard is similar to that of many others in like country — namely, the absolute necessity for early and deep ploughing, good cultivation, rolling, and the formation of the soil mulch to the requisite depth so as to save the winter moisture for summer crop-production.

Dry-culture methods were tried last season on the farm of Mr. H. S. McCully, of Waitohi, near Pleasant Point, South Canterbury. A field of approximately 50 acres was sown in rape on 15th November, and manured with rape-fertilizer at the rate of 1 cwt. per acre. Portion of the field was worked under dry methods, being intercultivated by Mr. McCully for the purpose of conserving moisture, allowing aeration of the soil, and destroying weeds. The value of this method was apparent from the earliest stages of the experiment, and at the end of the season was exemplified to a wonderful degree. The plants of rape growing on the dry-culture area were giants in comparison with those on the remainder of the field. The root-system of the former was vigorous, and the plants were not checked in growth during dry spells, as were those growing on the remainder of the field. The advantages of dry farming as shown in this experiment are of outstanding importance.

It has been estimated that the dry-culture area gave a yield of fodder at least 400 per cent. in excess of the portion grown under ordinary farm practice. The field was inspected by Mr. J. T. Smart, Director of the Technical School, Temuka, and he has certified that the experiment and result were as stated. From the photograph here reproduced it will be seen that the estimated increase is quite a conservative estimate. From an inspection of some of the plants by the writer he is of opinion that 600 per cent. would be quite within the mark.

RAPE-PLANTS FROM THE FARM OF MR. H. S. McCULLY, WAITOHI, SOUTH CANTERBURY.

On left, representative plant from part of field worked under dry-farming methods — rows 21 in. apart, intercultivated. On right, representative plant grown under ordinary practice in same field.

[*Photo by W. Holwell.*

Under dry-farming methods production could thus be enormously increased. On many farms even with a marked decrease of area under crop the results under a system of dry culture would be much greater than at present. The soil conditions would be improved, and each succeeding crop would derive substantial benefit from the intercultivation of the preceding one.

FRUIT COOL STORAGE.

HANDLING EXPERIMENTS IN 1920 SEASON.

W. H. RICE, Orchard Instructor, Hastings.

DURING the season of 1919 the Horticulture Division carried out in Hawke's Bay comprehensive experiments in the picking, handling, and packing of apples and pears for cool storage, concerning which a report was published in the *Journal* for January, 1920. The experiments were continued last year, and the matter which follows should be read as supplementary to the previous report. The 1920 experiments were designed to specially test the following points: (1) The best stage of maturity at which to pick fruit for successful cool storage; (2) the value of wrapping against non-wrapping of fruits prior to storage; (3) the effect of russeting on the value of fruit for storage; (4) methods of handling: grading and packing in the orchard—wrapped and unwrapped—*versus* grading in the orchard, conveying the fruit in orchard cases to the store, and then packing before storage.

STAGE OF MATURITY AT WHICH TO PICK APPLES.

Eight varieties of apples and three varieties of pears were used for this test. As the cases were made with newly cut timber, it was found impracticable to check the loss of weight during storage. All dates apply to 1920.

(1.) *Cox's Orange Pippin.*—Two pickings were made, on 23rd February and 2nd March. The fruit picked on each date was graded into two stages of maturity. The fruit was removed from store and examined on 14th June.

(*a.*) First picking: Had a well-defined yellowish ground colour, with blush and stripe. On removal from store this fruit was in excellent condition, but ripened rapidly and became soft-ripe in ten days. Duplicate cases in each instance showed that wrapped fruit was riper and brighter in appearance.

(*b.*) First picking: Just on change to light yellow in base colour, with light blush. This fruit stored well and ripened up well, with defined yellow; very attractive, though only about 10 per cent. of colour. Ripened more slowly than (*a*) after removal from store; still in good marketable condition twenty-one days after removal.

(*c.*) Second picking: Yellow; stripe and blush dull. Behaved in a similar manner to (*a*) under storage, but became dry and mealy-fleshed seven days out of store.

(*d.*) Second picking: Greenish-dull, little or no colour; firm when removed from store, and only attained low and unattractive colour except wrapped, which was brighter and riper. Shrinkage was rapid and pronounced when held ten days out of store.

The indications are that base colour is the factor which should govern picking—more so than blush—to secure best results. Fruits should be picked when the green base colour is inclined to yellow; if

allowed to remain on trees to colour up, although more attractive at picking-time, the storage period is shortened, and also the period of marketing.

(2.) *Dunn's (Monroe's Favourite).*—Two pickings were made, on 25th February and 5th March, and the fruit graded into two stages of maturity on each date. Removed from store 5th July.

(*a.*) First picking: Well-developed fruits as to size; only very slight change of ground colour, with light blush. When removed from store, firm and greenish, unattractive, inclined to shrink, and became very spongy and wrinkled in skin fourteen days after withdrawal. Wrapped fruits no improvement.

(*b.*) First picking: Though well up to size, no change of ground colour. When removed from store were limp and green; did not ripen, but shrivelled very rapidly. Wrapped fruits similar, except more brilliant green.

(*c.*) Second picking: Well-defined yellowish ground colour, regardless of blush. When removed from store very attractive, firm; ripened well and kept well out of store, conditioning gradually with no shrinkage. Wrapped fruits brighter, cleaner, and more refined skin-texture.

(*d.*) Second picking: Green ground colour, with good blush (high-coloured fruits with basal colour undeveloped). When removed from store there was little or no development of ground colour, which remained green, and though in contrast with a good blush the sample was not nearly so attractive as the yellow and light blush fruits of (*c*). Wrapping in no way improved the condition or affected the skin wrinkle and shrivel, which was pronounced at fourteen days.

The indications are that, whenever picked, ground colour should be present if fruits are to ripen under or after storage in anything like good condition with attractive appearance. Yet if the ground colour is a very pronounced yellowish-white, there is a risk of dryness and mealiness of fruit under storage.

(3.) *Jonathan.*—Two pickings were made, on 4th and 12th March, each picking being divided into two grades of maturity. Removed from store 15th June.

(*a.*) First picking: Well-defined yellowish ground colour, with good blush. Excellent order when checked; firm, nice-conditioned fruit, very attractive, especially when wrapped, which added brilliancy to the skin. Remained in good marketable condition up to twenty-one days.

(*b.*) First picking: Greenish ground colour, with medium blush. When removed, very moderate condition, firm, greenish and dull, inclined to skin-wrinkle ten days after removal. Wrapping no appreciable improvement.

(*c.*) Second picking: Similar fruits to (*a*), but eight days more advanced. When removed, equal in immediate condition to (*a*), except riper and more subject to bruise; inclined to be mealy and dry after fourteen days, particularly wrapped fruits.

(*d.*) Second picking: Similar fruits to (*b*), but eight days riper, and showing pronounced yellow tinge on ground. Conditioned up in good order, yellow and inclined to be mealy; ripened very rapidly on removal, being soft-ripe in fourteen days.

(*e.*) Various grades of maturity and russet: In all cases this fruit shrank under storage. Well-coloured fruits became soft and pliable, while greenish fruits were leathery.

Comparisons indicate that well-coloured fruits should be picked only when ground colour is showing a defined yellowish tinge, otherwise the shrinkage of green parts is bad. Fully developed fruits with apparent change to yellow in base should not be allowed to hang on tree to attain blush if maximum keeping is desired, as such fruits are inclined to be soft and mushy after removal. Russeted fruits should be disposed of before shrinkage, and to facilitate this should be stored in separate cases.

(4.) *Lord Wolseley.*—Two pickings were made, on 15th and 24th March, and each separated according to maturity. Removed from store 14th June.

(*a.*) First picking: Well-developed white to yellow ground colour, and left the spur freely. Removal showed these fruits to be well selected, firm, well conditioned, bright and attractive; conditioning gradually after storage, with no shrinkage up to twenty-one days. Wrapped fruits brighter and riper, but not to mealiness.

(*b.*) First picking: Greenish colour, with only light suffusion of white to yellow. When removed firm, no colour-development, very dull compared to (*a*); no improvement wrapped. Inclined to skin-wrinkle fourteen days out of store; firm up to seven days. Five per cent. of bitter-pit noticed in this section only.

(*c.*) Second picking: Similar to but seven days riper than (*a*); decided yellow. When removed equal to (*a*) in appearance; considerably more liable to bruise, and conditioned rapidly within seven days. Mealy-overripe after fourteen days.

(*d.*) Second picking: Green though full grown. When removed dull green, except wrapped fruits, which were bright green. Did not take on yellow ground colour prior to shrinkage; leathery condition within fourteen days.

The results indicate fruits should be picked with well-developed whitish colour to yellow tinge. When left on trees to advanced riper stage bruise more readily, do not allow such a reasonable marketing-period, and inclined to be mealy. Fruits with undeveloped colour when picked shrink rapidly after storage, thus demonstrating that the varying maturities should be stored separately to get best results. More selection required than with most varieties to get all at correct stage.

(5.) *Delicious.*—Two pickings were made, on 16th and 23rd March, each being divided into two stages of maturity. Removed from store 3rd August.

(*a.*) First picking: Definite change of ground colour to yellow, with good bright blush; picked readily. Removal showed these fruits in good condition, firm, crisp, and bright-coloured; kept well after storage, remaining full-flavoured and in excellent marketing condition up to twenty-one days.

(*b.*) First picking: Only light tinge of yellow in ground colour, with dull blush. When removed, firm, crisp, good condition, but not so attractive as more advanced when picked. Green had taken on a light yellow, but when conditioned was inclined to toughness.

(*c.*) Second picking: Similar, yet seven days riper than (*a*). Decided yellow ground, with full blush. Removed from store as (*a*),

but more advanced ripeness and decidedly more subject to bruise. Conditioned to overripeness within fourteen days from store.

(*d*.) Second picking: Similar to (*b*) but seven days riper. Well-advanced yellow ground, but only light blush. Conditioned rapidly after storage; inclined to be mealy, though bright yellow and crisp when removed. Brighter colour and advanced ripeness due to wrapping.

Results indicate that the fruit should be picked when ground colour is well defined, regardless of blush. Fruits left to advanced maturity on tree do not store so well, are more subject to bruise, and do not allow same latitude of disposal. Uncoloured (blush) fruits should also be picked when ready, and may then be expected to mature gradually in good order, though not high-coloured.

(6.) *Sturmer*.—Two pickings were made, on 30th March and 7th April. Removed from store 23rd September.

(*a*.) First picking: Well-defined light-yellow change of ground colour, with traces of leaf-green. When removed from store proved firm and crisp, and kept well, conditioning very gradually.

(*b*.) First picking: Good bright blush, but basal colour still green. When removed from store, still green and firm, but developed a flexible condition; instead of ripening became limp and tough-fleshed in twenty-one days.

(*c*.) Second picking: Similar fruits but seven days riper than (*a*). Meanwhile had developed a pronounced yellow ground. When removed from store, bright, firm, crisp, and rather dry. Very attractive appearance, but bruised readily, this showing up very distinctly, and rapidly decayed. Limited marketing-period, as most fruits proved mealy in fourteen days.

(*d*.) Second picking: Spray-russeted fruits in various grades of maturity and blush. When removed from store it was found that shrivelling had taken place in all fruits. The worst specimens were those of low maturity, then those of reasonable maturity with confluent russet, and to a much lesser extent, but still sufficient to affect the condition of the fruit, those specimens on which russet was scattered over the surface.

The results indicate that change of ground colour should be present when picked, and that all fruits should be packed separately, according to maturity. 5 per cent. of confluent russet is more damaging to the ultimate condition of the fruit than 10 per cent. scattered.

(7.) *McMahon's White*.—These fruits were graded, packed, and cooled-stored on 20th April from fruits picked on 14th April, and held in the fruit-shed at Arataki Horticultural Station. Removed from store on 7th September.

(*a*.) Well-developed yellow ground colour, with mixed blush. When removed from store, firm but dry and mealy. Examination from time to time in store showed that this fruit was in the best-quality marketing condition in the early part of August.

(*b*.) Light change of ground colour with mixed blush and traces of leaf-green showing. When removed from store this fruit was in excellent condition, and remained so for twenty-one days. Fruits allowed to remain in store attained their maximum fair marketing condition by mid-November.

(*c*.) Mixed maturity with spray russet, and all grades of blush. When removed from store all fruits had shrivelled according to the degree

of russet. Shrinkage was more pronounced where russet was confluent; with specimens well matured it was only such parts that shrivelled; scattered russet up to 10 per cent. caused no material defect.

This variety should fill a place between Delicious and Sturmer, and thus prolong the season for consumers who have a preference for apples of the Delicious flavour.

(8.) *Dougherty.*—Two pickings were made, on 19th and 25th May, and graded for maturity. Removed from store 26th November.

(*a.*) First picking: Well-coloured fruits, with leaf-green replaced by light yellow. When removed from store proved in excellent condition and in no way deteriorated in fourteen days.

(*b.*) First and second picking: Well-coloured fruits, with leaf-green unchanged. When removed from store were firm, crisp, and juicy, but did not ripen well, becoming rather dry and pliable in fourteen days.

(*c.*) Second picking: Well-coloured fruits, with advanced yellow in contrast. When removed from store were firm, crisp, dry, and below full flavour of the variety. Remained firm but dry and mealy, with rapid decay where injured by handling or in transit.

(*d.*) Spray-russeted fruits of various grades of maturity. When removed from store shrivel was only apparent in fruits of low maturity. When compared to (*b*) this would suggest that russet was the cause of more shrinkage than undermaturity, except in the case of very pronounced undermaturity. In the course of fourteen days the ill effects due to russet became very apparent—shrivelling in the instances of heavy and confluent russet, and skin-wrinkle of fruits with moderate scattered russet.

This variety, like others, gave the best results when picked with a distinct change from leaf-green to yellow of the ground colour. The results would also suggest that much of the mealy condition so common in this variety when stored is due to it being allowed to hang on the trees regardless of advancing maturity.

Pears.

(1.) *Beurre Diel.*—Two pickings were made, on 9th and 15th March, and divided into two grades of maturity. Removed from store 9th June.

(*a.*) First picking: Very slight change of ground colour, but picked readily. Proved on removal from store to be bright, well-coloured, firm, crisp fruit. Wrapped fruits brighter but not riper; no inclination to shrivel or mush.

(*b.*) First picking: No change of ground colour, but left spur readily. When removed were bright and greenish, otherwise equal to (*a*). Musty odour in all wrapped fruits, which affected flavour.

(*c.*) Second picking: Picked readily. About equal to (*a*); more advanced not possible, as all fruits left to yellow fall to the ground. When removed from store were nice bright, well-coloured fruits, firm, crisp, and equal to (*a*). Musty when wrapped.

(*d.*) Second picking: Inside fruits not so mature and harder to pick. When removed were greenish and hard, shrinking to leathery condition instead of ripening.

Results indicate that fruits should be picked when easy to sever from tree. Greenish fruits should be avoided for storage. Wrapping gives brighter colour and somewhat retards ripening, but gives musty odour, which was not noticeable with other varieties tested.

(2.) *Winter Cole.*—Two pickings were made, on 18th and 26th March, and each graded to two stages of maturity. Removed from store 21st June.

(*a.*) First picking: Well-defined yellowish colour; picked readily. Removed from store in splendid condition, firm, bright, well coloured, and conditioning gradually after removal. Wrapping delayed ripening but added lustre to the skin.

(*b.*) First picking: Greenish ground, yet picked readily. When removed fruits were firm, crisp, and not so well coloured as (*a*), and took longer to condition; were not full-flavoured, and greener fruits shrunk at the stem end.

(*c.*) Second picking: Similar fruits eight days riper than (*a*). Distinct yellow. At removal equal to (*a*); ripened much more rapidly after, and fruits bruised more readily.

(*d.*) Second picking: Greenish to yellow; picked readily. Stored in splendid order; firm, bright, crisp, and well coloured; same fruit as (*b*) eight days riper. Has well demonstrated the value of leaving to more maturity on tree.

Results indicate uniformity of storage if ground colour is used as a guide. Greener fruits should be allowed to remain to change base colour. Wrapping delayed ripening.

(3.) *Winter Nelis.*—Two pickings were made, on 9th and 16th April, with each graded into two grades of maturity. Removed from store 6th August.

(*a.*) First picking: Changing to yellow, well defined but not advanced. When removed from store were well coloured, firm, crisp, and full-flavoured. Conditioning evenly and slowly with good marketing-period; nice condition up to twenty-one days.

(*b.*) First picking: Greenish, slight tinge of yellow only. When removed from store, greenish and soft; very unattractive, limp and soft after seven days.

(*c.*) Second picking: Well-defined yellow ground; picked very readily. Seven days riper than (*a*). On removal from store were ripe and juicy, being ready to use immediately; bruised badly, indicating ripening on tree and shortening of storage period advisable; should be stored separately and marketed earlier.

(*d.*) Second picking: Greenish; hard to sever from tree. On removal from store were greenish, soft, and pliable; did not mature after storage, but shrunk to a limp condition in fourteen days.

The results indicate that several pickings (selections) are necessary to catch this variety in good order. Fruits must be graded into separate cases according to maturity, prior to storage, if the various classes are to be marketed in proper season.

Summary.

The experiment just detailed indicates that there is a certain stage of maturity which allows the best results to be obtained, that stage being indicated by a distinct change of ground colour towards light yellow from leaf-green. Fruits picked which had no change of ground or basal colour proved not only to shrink under storage, but were unsuitable fruits to condition after removal, being inclined to shrink dry and leathery rather than ripen. On the other hand, fruits which were of an advanced yellowish ground colour proved mealy when stored

for the average period of the variety, and mush-ripe very soon after. The lesson to be learned is that fruit should be picked when there is a distinct change of ground colour, regardless of the high colour or blush.

With the fruits graded according to standard colour requirements when packed it was noticeable that there was no further development in intensity of high colour, but the development of ground colour provided a contrast which improved the appearance of the fruit.

With the yellow or green varieties close observation shows that the leaf-green passes through a whitish shade before turning yellow. The stage when this whitish-yellow is the dominant ground colour proved the best for picking such varieties.

Evidence goes to show that leaving fruit on the trees to attain a high colour or blush after the change of ground colour results in speedy ripening under storage, with a consequent shorter storage period and fruit which lacks that desirable crisp and juicy quality. Such fruit is practically ripe when removed from the trees, and ready for immediate sale in the case of early and mid-season varieties. If in the case of later keeping varieties this condition of ripeness is unavoidable, such advanced fruits should be stored in separate cases to permit withdrawal from the store while still in good condition.

Beurre Diel pear presents a somewhat difficult proposition regarding the best stage at which to pick. Fruits leave the spur readily, and many fall before there is any colour to indicate approaching maturity.

Pip-colour development gave such a wide variation throughout the test that it appears to be of little assistance in selecting the stage at which to pick for storage.

WRAPPING FRUIT PRIOR TO STORAGE.

There were six classes of wrapped fruit, comparable with fruit similar in all respects but not wrapped: (1) Fruits with greenish ground colour packed in orchard; (2) fruits with greenish ground colour packed in store; (3) fruit with leaf-green changed to yellow packed in orchard; (4) fruit with leaf-green changed to yellow packed in store; (5) fruits with well-advanced ground colour packed in orchard; (6) fruits with well-advanced ground colour packed in store. Results were noted as follows:—

Apples.

(1) and (2). Wrapping was no improvement on unwrapped in any way.

(3.) Wrapped fruit had a brighter general appearance, and, though slightly riper, still retained firmness of texture. Though there was some improvement due to wrapping, there was not sufficient to warrant the extra expense for local storage, except with fruits of a special character, such as show fruits.

(4.) Similar to (3), with the added advantage which wrapping gave by confining the spread of decay to specimens injured at picking-time and in transit to the store.

(5.) Wrapping was a disadvantage in so far that it further hastened ripening.

(6.) Similar to (5), except that spread of decay was restricted.

Pears.

(1) and (2). Wrapping caused a still more shrivelled and leathery condition, particularly from the stem end.

(3.) Wrapping gave a brighter skin and somewhat retarded ripening.

(4.) As (3), with spread of decay confined to injured specimens.

(5.) Wrapping was an advantage by delaying ripening, but not sufficient to recommend commercial usage for local market, except perhaps with Winter Cole well advanced when picked.

(6.) As (5), with decay localized by wrapping.

These remarks do not apply to Beurre Diel, as wrapped fruits of this variety in every instance developed a pronounced musty-wine odour, the flavour also being tainted musty.

SPRAY-RUSSETED FRUIT.

Spray-russeted fruits of each maturity were selected and packed separately. Various degrees of russeting were noted, as also was the confluent or scattered nature of the skin-injury. The effect of russet on the storage period was very marked. In all grades of maturity there was a decided shrivelling of the fruit, general with fruits inclined to undermaturity, and confined to the russeted portion in the case of more advanced fruits.

Fruits which were good in every way but for russet exceeding 5 per cent. if confluent and 15 per cent. if scattered shrivelled badly at the russeted portion, while the clear-skin section of the same specimen would be quite firm when subjected to the normal storage period of the variety.

As russeted fruits remain firm a very limited time only when cool-stored, they are best stored in separate cases, so that they may be removed while still of some value.

It was very clear that russeted and clear-skinned fruits of the same variety have two distinct storage periods if each are to be marketed to the best advantage.

HANDLING TEST: PACKING IN ORCHARD VERSUS PACKING IN STORE.

The handling tests consisted of testing the methods (1) and (2) specified below—namely, packing the cases in a compact manner prior to cartage, which gave such good results in the previous experiment—against (3), the usual local practice of carting fruit to the store loosely emptied into cases. The fruits were picked carefully in the usual way into a picking-bag and emptied on to a portable grading-table with canvas bottom, the table being placed in the shade. The fruit was then graded for quality and maturity and treated as under:—

(1.) Wrapped and packed into case on the diagonal or pocket-pack system, with wood-wool top and bottom, and the lid nailed down in the usual manner.

(2.) Same as (1) but not wrapped.

(3.) Graded from table, handled carefully into cases, and lightly shaken down to settle the fruit, the whole being then conveyed to the central packing-shed and cool store in the same conveyance. The section (3) was then divided, and some wrapped and the others packed pla :s (1) and (2) had been treated in the orchard.

All cases were then placed in the precooler on the same day, and from there passed to the cool chamber without unnecessary delay.

Notes taken on the various comparisons show that (1) and (2) gave excellent results, and were a great improvement on (3), which resulted in a bruised and in many instances skin-punctured condition of the fruit before the further handling required in packing at the store.

The results amply demonstrated that serious damage is done to fruit when the cases are irregularly filled at the orchard and shaken down in transit to the store, and that such damage may be eliminated almost entirely by packing the fruit in an orderly manner in the case before carting. The ultimate condition of the fruit well repays the extra trouble, not only where it has to be repacked at the store for a special purpose, such as export, but also for local market. Further, it is in a condition for prompt storage, which is a very important factor in the treatment of fruit intended for cool storage, as shown by the report on last season's experiments.

The results of this experiment again demonstrated the important bearing that proper selection, handling, and transit to the store has on the ultimate successful cool storage of fruit. Unless these points are carefully attended to, even an efficient cool chamber cannot give the best results.

I wish to record my appreciation of the valuable assistance and co-operation rendered by the managers of Messrs. Apsey, White, and Co. (Limited), and the Hawke's Bay Fruitgrowers (Limited), which very materially assisted the experiments.

NOTES ON WOOL-CLASSING.

J. G. COOK, Wool Instructor, Live-stock Division.

IN no other work is one called upon to adapt himself to circumstances more than in wool-classing. It is necessary to vary the procedure according to the clip one is handling, as indicated in the following notes, which are supplementary to the writer's article, "Wool-handling at Shearing-time," published in the *Journal* for November, 1920.

MIXED FLOCKS.

Two leading examples will be given, the first being fairly typical of South Island conditions. This flock is a mixed one of about three thousand sheep, all carrying clean, strong, shafty wool, and consisting of half-breds, three-quarter-breds, crossbreds, and merinos. The majority being half-breds, two classes should be made of that fleece wool. Into the first wool-bin put the finest and best fleeces, and after it is pressed brand the bale "A Combing Half-bred." Into the second bin put the coarser and heavier-conditioned fleeces, branding the bale "B Combing Half-bred." Into the third bin put the finest and best of the three-quarter-bred fleeces, branding the bale "A Combing Three-quarter-bred." Into the fourth bin can be put the coarsest of the

three-quarter-bred and the crossbred fleeces, as it will be found they are of about the same spinning-quality; and as there will be only one line of this, brand the bale "Crossbred Combing." The fifth bin will be used for the merino fleeces, and the bale branded "Merino Combing," as there is only one line.

Farmers could save a great deal of this cutting-up if they would breed and keep to only one or two lines, thus reducing the number of classes to a minimum and enabling the clip to be put up in larger lines, which is more convenient at sale-time.

The other example will be a flock—such as very commonly found in the North Island—comprising Romney, Romney crossbreds, and Lincoln crossbreds. Here we have three distinct lines, and they must be kept separate from each other. These sheep as a rule grow strong shafty combing-wool, and if the lines are in equal proportion A and B combing should be made in each line.

SEEDY CLIPS.

Sometimes the whole clip is seedy, and if there is only one breed of sheep on the place two classes should be made, one containing the fleeces which are slightly seedy and the other those which are carrying the most seed. The former should be entered in the wool-book as "Slightly Seedy" and the latter "Very Seedy." In the event of the flock being a mixed one and all the wool seedy, keep each line separate from the others and enter it according to whichever line it belongs, such as "Seedy Romney Marsh," "Seedy Romney Cross," "Seedy Lincoln Cross," "Seedy Merino," and so on.

DINGY CLIPS.

In some seasons the whole clip is dingy, and if there is only one line of sheep on the farm two classes should be made of the fleece wool. One class will embody all the strong fleeces which will stand the tension of the combing-machine; the other class will take in all the weak tender fleeces. Enter the former line as "Dingy Combing" and the latter as "Dingy Clothing." If the flock is a mixed one and all dingy, keep each line separate from the others and enter it according to whichever it belongs, as follows: "Half-bred Dingy," "Crossbred Dingy," "Merino Dingy," and other lines in the same way.

WOOL-BOOK ENTRIES.

The farmer or person acting for him should remember to enter in the wool-book the description of wool in each bale as soon as possible after the bale is out of the press, thus obviating errors, and the book will always stand as a record for reference purposes.

Departmental Exhibits at Shows.—The Department has decided to revive to a limited extent the practice of making instructional displays at certain agricultural shows, the temporary discontinuance of which was rendered necessary during the war. The exhibits work will be in charge of Mr. A. Macpherson, late Fields Instructor at Christchurch, as in the past.

EXPORT OF FRUIT.

THIS SEASON'S REQUIREMENTS AND CONDITIONS.

J. A. CAMPBELL, Assistant Director of the Horticulture Division.

THERE are necessarily many problems to be overcome in the process of developing an export trade. Many of these are obvious at the outset, and their solution may therefore be attempted straight away, but others not anticipated have the unhappy knack of cropping up in the course of actual practice. Something of the kind has been our experience as a result of our modest shipments of fruit to England last year. As this business is likely to be on a very much larger scale, and the new season is about to commence, a little advice to growers and packers at this stage may be of value.

FRUIT-CASES.

The export case provided by the regulations has an inside measurement of 10 in. by 11¼ in. by 19¾ in. The Canadian standard case, which will also be accepted, has inside measurements of 10½ in. by 11½ in. by 18 in. Except that the tops and bottoms of the Canadian cases are thinner and are used with a cleat, the timber for construction is practically the same as in our own. In fact, the tops and bottoms of the New Zealand standard case should be reduced in thickness and used with cleats also. In shape either case is satisfactory. For local purposes our own case has stood up to its work quite well, giving little or no trouble. Therefore the alarming manner in which many of these cases collapsed when being loaded on to the oversea boats at Wellington last year, and later, it is understood, on the wharves in London, constituted one of the unlooked-for but none the less serious incidents in connection with the success or otherwise of this trade.

It is of course obvious to any one that this cannot be allowed to continue. The first consideration with respect to any package is stability. Whatever size or shape it might be, it is worse than useless if it fails to land its contents successfully at its destination. Unfortunately, the class of timber from which cases are made is usually poor stuff at best. However, bad as it often is, it usually lends itself to a certain amount of selection, and this selection, so far as intending exporters are concerned, should be practised without fail and only the best timber selected for the construction of export cases.

In this connection the following advice is given: (1.) Select the best timber on hand for the construction of export cases, reserving that of poorer quality for local marketing purposes. (2.) Overseasoned timber should not be used. (3.) Six-inch and four-inch side boards should be used, and the order of their use should be reversed on either side of the case; this will tend to strengthen the grain and prevent end-splitting. (4.) Nails stouter and longer than ordinary should be used, and should be driven on the skew and dovetail plan. (5.) Cases or case-timber should be stacked under cover or made up just prior to packing; they should not be exposed to the weather, particularly to

a hot sun. (6.) When packed all projecting ends should be shaved off flush, otherwise the case will be liable to be torn to pieces in the process of handling.

As a further safeguard against damage to cases in transit the adoption of a simple process of wiring recently made available is strongly advocated. Full particulars regarding this process may be had from the general manager of the Fruitgrowers' Federation, or the agent, Mr. H. Hoare, Dixon Street, Wellington.

COLOUR STANDARDS.

The standard of colour required by the regulations has been held responsible by certain English agents for a certain proportion of our fruit arriving on the market in an overmature state. This conclusion is held by the writer to be altogether incorrect, the overmaturity of the fruit having been due to unavoidable delay at this end after the fruit was in the cases, rather than to its being held on the tree too long in order to allow it to assume the required amount of colour. However, certain relaxations in the colour standards have been made with respect to fruit being shipped to European markets during the coming season, as will be seen in the amended export conditions quoted later on.

REGISTERED EXPORT NUMBER.

The absence of a distinguishing mark on fruit-cases submitted for examination has several times in the past placed the Inspector in a difficult position. In these instances a small percentage of the line, possibly the fruit from a single orchard, has been found to be well below the standard required. In such circumstances the Inspector has had either to pass fruit which should not be passed, as there has been no means of distinguishing the cases objected to from the remainder of the stack, or to condemn the whole line of possibly several hundred cases, thereby causing a heavy and unnecessary loss to the association concerned. The branding of the cases with the grower's registered number will overcome this difficulty, and packing associations are likely to be thereby more than well compensated for the little extra trouble involved.

EXPORT REGULATIONS.

With respect to the fruit-export regulations, it has been decided by the Department to allow the following modifications for the season 1921:—

COMBINED GRADE-MARKS.

Apples conforming to the requirements of "Extra Fancy" and "Fancy" may be packed together in the same case, but in all such instances where the resultant pack runs 50 per cent. and upwards of fruit carrying the colour requirement of "Extra Fancy" the case or cases must be branded with the combined grade-mark abbreviated to "Extra and Fancy Combn."

In all instances where the resultant pack runs less than 50 per cent. of such highly coloured fruits the case or cases must be branded with the lower grade-mark of "Fancy."

CLASSES.

The existing partial red and striped class will be divided and a distinct striped class instituted. The colour requirements of the striped class will be 33⅓ per cent. and 20 per cent. respectively of good typical colour for "Extra Fancy" and "Fancy" grades.

COLOUR STANDARDS.

Notwithstanding the provisions of the regulations, which will not be altered in this respect until further experience has been gained, apples carrying 10 per cent. less colour with respect to "Extra Fancy" and 5 per cent. less colour with respect to "Fancy" than is required by the regulations will be accepted during the 1921 season for export to Europe only.

The above reduction in colour will apply to all the grade classes, including the newly introduced striped class above referred to.

REGISTERED EXPORT NUMBER.

The "registered number" issued to all growers under the "Local Market Regulations" will be declared to be the grower's registered export number also. The registered number of each grower must be branded on each case of fruit exported by him, whether packed by the grower himself or packed and shipped through a packing association. The characters used in connection with such number shall be not less than $\frac{3}{4}$ in. in the case of stencils.

MINIMUM AND MAXIMUM SIZES OF APPLES FOR EXPORT TO EUROPE.

The minimum size of fruit approved for export for the above purpose will be 210 per case (= $2\frac{1}{4}$ in.) with the exception of those varieties marked * in the appended lists. With respect to the varieties so marked the minimum will be 175 per case (= $2\frac{1}{2}$ in.).

The maximum size with respect to all varieties will be 90 per case (= 3 in.).

MINIMUM AND MAXIMUM SIZES OF APPLES FOR EXPORT TO SOUTH AMERICA AND OTHER MARKETS.

The minimum and maximum sizes of apples approved for export for the above purposes will be 175 per case (= $2\frac{1}{2}$ in.) and 72 (= $3\frac{1}{2}$ in.) respectively.

AGE OF TREES.

The regulations restricting fruit for export to that taken from trees of seven years of age and upwards will still remain in force, but arrangements will be made during the coming season for experimental shipments of fruit to be made from trees of a lesser age than seven years.

STENCILLING AND LABELLING.

Herewith is a facsimile of a stencil reduced in size according to scale, and it is issued for the guidance of growers. The stencil suggests the minimum wording required. "New Zealand Apples" must be in not less than 1 in. lettering; registered export number not less than $\frac{1}{2}$ in. with respect to paper labels and not less than $\frac{3}{4}$ in. with respect to stencils; "Packed for Export" not less than $\frac{3}{4}$ in. "Raroa" takes the place of the packing-shed, orchard, &c., and should not be less than 1 in. lettering. "120" represents the number of apples in the case. This, together with "Fancy" and "Jonathan," will in most instances require to be branded by means of rubber stamps, the lettering of which should be not less than $\frac{3}{16}$ in. Paper labels, apart from any form of ornamental design, must also bear the wording represented by the stencil copy.

Application for export brands or labels, together with facsimile of such brands or labels, must still be made to the Director of the Horticulture Division.

APPLES, PEARS, AND PEACHES APPROVED FOR EXPORT.

Those marked * are limited to a minimum size of 2½ in.; those marked † must be specially good of the variety to secure the Government guarantee.

Apples.

Solid Red Varieties.

Baldwin.	King David.†	Tasma.
Hoover.*†	Spitzenberg.	

Partial Red Varieties.

Crofton.	Rome Beauty.*	Shepherd's Perfection.
Delicious.	Scarlet Nonpareil.	Wealthy.†
Dougherty.	Scarlet Pearmain.	Worcester Pearmain.
John Sharp.†	Sharp's Late Red.*	Yates.
Jonathan.		

Striped Varieties.

Adams Pearmain.	Gravenstein.	Statesman.
Allington Pippin.	Premier.	Stayman.
Cox's Orange.	Ribston Pippin.	

Yellow or Green Varieties.

Boston Russet.†	Golden Pippin.	Reinette du Canada.*†
Brownlee's Russet.†	London Pippin.*†	Sturmer Pippin.
Cleopatra.	Newtown Pippin.	Willie Sharp.
Dunn's Favourite.*	Parlins Beauty.*	

Pears.

Bachelier.	Doyenne du Comice.	L'Inconnue.
Beurre Bosc.	Duchess d' Angouleme.	Marie Louise.
Beurre Capiaumont.	Durondeau.	Packham's Triumph.
Beurre Clairgeau.	Elizabeth Cole.	P. Barry.
Beurre d'Anjou.	Giblin's Nelis.	Twyford's Monarch.
Beurre Diel.	Glou Morceau.	Winter Cole.
Beurre Easter.	Josephine de Malines.	Winter Nelis.
Directeur Hardy.		

Peaches.

Elberta.	Kia Ora.	Sea Eagle.
Golden Queen.	Lippiatt's Late Red.	Sea Eagle Improved.
Hobbs's Late.	Paragon.	Solway.
James' Cling.	Prizetaker.	Wheatland.
Kalamazoo.		

GOVERNMENT GUARANTEE.

The following are the conditions of the Government guarantee of a net return of 1d. per pound on fruit exported during the season 1921:—

The guarantee is to be limited to 200,000 cases of approved varieties and classes of fruit.

The Government liability under the guarantee extends to the same charges for the packing, shipment, &c., of the fruit, as was the case during the last season.

It is a condition of the offer of the guarantee that all fruit exported under it must be covered by an all-risk insurance policy.

The guarantee be limited to fruit grown and shipped on consignment by *bona fide* fruitgrowers, and fruitgrowers' co-operative societies, through the New Zealand Fruitgrowers' Federation, provided that body affords equal shipping-facilities to all.

Notwithstanding that the offer applies to fruit shipped to any market, the Minister reserves the right to limit the quantity of fruit shipped to any particular market, should shipping-accommodation, freight rates, market conditions, &c., be deemed unsatisfactory.

The requirements in regard to the fruit passing the Department's Inspectors, in terms of the export regulations, will, of course, apply.

LUCERNE IN THE WAIRARAPA.

A SUCCESSFUL STAND AT KAHUTARA.

F. E. WARD, Instructor in Agriculture.

ONE of the most successful stands of lucerne in the Wairarapa is that of Mr. J. Carne Bidwill, at Kahutara, on the eastern side of the lake. A few years ago Mr. Bidwill, realizing the great value of lucerne as a green fodder and as hay, set aside a paddock of 20 acres with the intention of getting it ultimately into lucerne. The soil of the paddock is a dark friable loam with a loose subsoil — a typical lucerne soil. Drainage is mainly carried out by means of deep open drains, the water in these being at a depth of about 6 ft. A certain number of tile drains have also been laid in the wettest parts.

PART OF THE LUCERNE STAND AT KAHUTARA.

Second crop of this season—six weeks' growth—ready for cutting in December.

The paddock was ploughed and cropped with swedes in the first place. A crop of oats was grown, and harvested in January, 1913. The stubble was ploughed in and barley was sown in the early autumn. This barley was fed off with sheep during the winter, and was then allowed to grow till it reached the height of about 9 in., when it was ploughed in for green manure. In September burnt lime was applied at the rate of 1 ton per acre and the ground again ploughed. During the period which elapsed between this ploughing and the sowing of the lucerne the weeds were kept in control by means of the tine harrows, which were put over the ground several times. Just prior to sowing the land was rolled with a Cambridge roller, and inoculated soil was applied at the rate of 1¼ cwt. per acre. This was harrowed in, and the seed-bed finally prepared with the roller. Sowing was carried out in November with the Marlborough variety, at the rate of 15 lb. per acre. The seed was mixed with 2 cwt. of basic slag, and the mixture

sown, practically broadcast, through the manure-box of a drill with the coulters removed. The seed was covered with a cross-stroke of the roller.

Four cuts have been taken from the stand each season since the year of its establishment. After every cut the crop has been harrowed with sharp-pointed tine harrows. Two years ago a Berger lucerne-cultivator was put over the stand twice to eradicate grass and weeds which had established themselves, and it is intended to repeat this operation each year, as it was distinctly beneficial. In the autumn of 1916 the stand was top-dressed with carbonate of lime at the rate of 1 ton per acre. On account of unsettled weather and the presence of weeds, &c., in spring, the first cut is usually made into ensilage, while the subsequent cuts are converted into hay. The yield for twelve months from the 20 acres in 1919–20 was 100 tons of ensilage and 100 tons of hay. The price obtained for the ensilage was £7 per ton and for the hay £9 per ton, this showing a gross return of £1,600 from the 20 acres.

THE 8 FT. ALBION MOWER.

The cutting of the crop is now done with a special Albion mower, which has an 8 ft. cut. Although this is nearly double the cut of an ordinary mower, two horses draw the implement easily, the draught apparently being very little greater than that of a 4 ft. 6 in. mower.

The success of the stand is due in no small degree to the care of Mr. D. K. Cameron, Mr. Bidwill's manager, who has seen to the details of the work and has carried them out in accordance with the Department's advice. Mr. Bidwill was so satisfied with the result of this lucerne stand that he put down elsewhere on the farm another 15 acres, which is now in its second year and doing very well.

LUCERNE-CULTURE DEMONSTRATION TO FARMERS BY INSTRUCTOR, AT KAHUTARA.

SHEEP-MANAGEMENT NOTES.

IV. DIPPING.

F. MACKENZIE, Inspector of Stock, Christchurch.

ONE of the most important operations in the management of sheep is the annual dipping. It is in the interest of every sheepowner to ensure that his flocks are efficiently dipped—that is, dipped so that the sheep will remain clean until the following shearing. In order to obtain satisfactory results it is necessary to use a poisonous dip. The different powder and other poisonous dips now on the market are all satisfactory. Great care should be taken to follow out the instructions on the packet or drum, as probably 50 per cent. of failures in dipping are due to owners neglecting to carry out the manufacturers' instructions.

One of the most common causes of failure is insufficient immersion. Each sheep should be held for at least one minute in the bath. This is absolutely necessary to obtain effective results.

Another cause of failure is dipping in a dirty bath. Nothing reduces the strength of a dip like filth, which also seriously affects the character of the wool. The bath should be cleaned out at intervals. It is impossible to lay down a hard-and-fast rule regarding the number of sheep passing through the bath before it requires cleaning, as this depends entirely on the condition of the animals. It only requires a limited number of sheep that have been travelled long distances, railed or shipped, to make the bath absolutely filthy.

A very serious mistake that has often come under my notice is the practice of making up a dip 75 per cent. poisonous and 25 per cent. non-poisonous. These two classes of dip are composed of entirely different constituents, and the one does not increase the strength of the other. A dip so constituted could be classed only as of 75-per-cent. strength, and I am certain that the condition of numbers of tick- or lice-infested sheep is due to this cause. The poisonous dip should be made full strength, with 25 per cent. liquid carbolic dip added. This is especially beneficial where the water is hard. Water can also be softened by the addition of about 3 lb. of washing-soda to every 100 gallons of water, or soap may be added until the water lathers on stirring.

During the last few years I have had to investigate several mortalities among flocks after dipping, and have found these due to blood-poisoning as a result of pigs or other animals having access to the yards or race leading to the dip. I recommended the addition of 25 per cent. carbolic dip, and although a large number of sheep were afterwards put through the same bath the mortality immediately ceased. Doubtless the non-poisonous dip acted as a very good disinfectant.

The following rules should be strictly observed in dipping: (1) Avoid dipping in wet weather; (2) measure accurately the bath-water; (3) dissolve thoroughly powder dip before using; (4) mix the dip properly; (5) thoroughly stir the bath; (6) immerse sheep for at least one minute; (7) use the dip full strength; (8) never dip in

a dirty bath; (9) if sheep are affected with lice, dip again at a fortnight's interval, as the eggs will hatch in about ten days; (10) on no account should a dog that is inclined to heel the sheep be allowed in the yards when dipping, as this is one of the chief causes of blood-poisoning.

SELECTION OF SEED-POTATOES.

W. H. TAYLOR, Horticulturist.

THE selection and treatment of seed-potatoes has been the subject of a great amount of literature as well as carefully carried-out experimental work. There is fairly general agreement on two points—namely, that immature sets are likely to produce the heaviest crop, and that whole sets about the size of a hen's egg are better than cut sets or tubers of smaller size.

It is not, however, to be concluded that nothing more is necessary than to plant sets of the size mentioned taken from an immature crop. A process of selection is necessary, or specially grown seed-tubers, else it might well happen—probably would, in fact—that such sets would produce a crop inferior to that obtained from sets cut from large tubers. It is well known that potato varieties deteriorate after being grown a certain number of years. The length of time they retain original characteristics varies in different varieties, and is greatly affected by the manner of selection for seed purposes. In a field of potatoes there are always found variations in the produce of the different hills. Some will give a good number of small tubers and a very small proportion of large. Others yield a small number of tubers, large tubers predominating. Both these types are bad, and a sure sign of weakening. Sets taken from such hills might be expected to reproduce themselves in a similar character. The produce would not be quite the same, but almost surely it would be inferior in character.

The life of a variety begins with the first stock of tubers raised from seed. Then commences the increase of the stock from tubers. During this process it is presumed that some selection is carried out, though it may not be much. The process is continued until there is a large stock ready for distribution. The value of this stock will depend on the constitution of the variety—that is, how it behaves under the stress of large production. The whole of this large stock had its origin in one seed, and the enormous reproduction from tubers only must have a weakening effect. A strong constitution, combined with care in selection, will maintain vigour in a variety for a long time; but without this care, no matter what the natural strength of a variety may be, it is bound to run out in a comparatively short time, or at least the produce of a field will be varied with some good hills and some bad ones.

The method of saving seed-tubers that is most common among farmers and others is to retain for planting tubers that are too small for sale or use as table potatoes, these being taken from the bulk. It follows that hills that produced a preponderance of small tubers are

the ones that supply most seed-tubers. Hills that produced a small number of tubers of any kind will also be represented. On the other hand, the hills that produced the best crops of good tubers will supply a very small number of sets. Thus the poor-cropping hills supply the bulk of the sets. It is reasonable to suppose that if large tubers were kept for planting, these being cut to suitable sets, better crops would result, and in most cases it would be so. This, however, depends on several things, the most important perhaps being that a proportion of the large tubers would come from hills of poor production. It is evident that deterioration is hastened by haphazard methods, and there can be no assurance of good crops being obtained in that way.

There are several methods of conserving the desirable characteristics of a variety and enabling the cultivator to reproduce them in his crops. One plan is to use for seed purposes large sets specially selected from good hills, or more roughly from crops that average good. There are several objections to this method, which need not be considered now. Another plan is to plant large uncut tubers specially to produce seed tubers. The sets being uncut, the expectation is to obtain from them a large number of seed-size tubers. The planting is done late, about Christmas-time. This secures tubers that are not overmatured, that are lifted late and consequently easily kept till planting-time, and that are the direct offspring of high-grade tubers. Quite obviously this is a more economical method than planting cut sets. A third method, and the best, is to go through the growing crop and dig the most promising hills, selecting tubers of the right size, and carefully storing them till planting-time. This should be done before the crop is fully matured, but not until the skin of the tubers is fairly firm. If the skin can be easily rubbed off it is too early to dig them.

A disputed point is that regarding the advisability of greening the tubers by exposing them to the sun. Like most things, the greening process can easily be overdone, but if judiciously carried out it has good points. If the tubers are lifted at the proper stage the skin will be somewhat tender, and in that state the tubers are easily bruised. A short exposure, just long enough to green the skin, will render it tougher, and there will then be no danger of rubbing it off or bruising. If, however, the tubers be exposed too long they will be in danger of burning, and corky patches may be formed, which would be injurious. Again, in some places where sun-heat is great and the soil becomes very hot they could not be exposed long without suffering injury. It is a matter for the exercise of common-sense. Where there is available a cool, airy building of some kind, in which the tubers can be placed in a thin layer, exposure to the sun is not necessary.

Probably the best method of treating lice on cattle, horses, and pigs is by applying kerosene emulsion. This is made by adding 1 lb. of soft-soap or good bar soap to 1 gallon of soft water, and allowing to simmer over a slow fire until the soap is dissolved; then remove from fire and add ½ pint of kerosene, stirring until it becomes of creamy consistency. Apply with a stiff brush. Another good dressing is an infusion of stavesacre. This is made by placing 2 oz., 3 oz., or 4 oz. of stavesacre in 1 gallon of boiling water. Let it stand for twelve hours, and apply as above. If a few ounces of soft-soap is added the mixture can be applied more easily. A second dressing may be necessary in eight or ten days in order to kill any lice that may have hatched since the first dressing.—*Live-stock Division.*

VALUE OF CULTIVATION IN ROOT CROPS.

A SOUTHLAND DEMONSTRATION.

W. ALEXANDER, Fields Instructor, Invercargill.

THE time appears opportune for drawing attention to the results of a test carried out last season on the Winton Experimental Area, from which some interesting data were obtained. In the course of the investigation into the cause of dry-rot of swedes certain plots were sown out under different manurial and intercultivation treatments, and running through the entire block were control or no-manure plots. It was not intended that any of the swedes should be sown and then left uncultivated, yet that was what actually happened in the case of one of these control plots, owing to a misunderstanding.

It was evident at a very early stage that the non-cultivated plot was in a bad way and that the yield was going to be low, a promise which was fulfilled. The accompanying photos, taken last August, will go far towards confirming the following particulars of the respective yields.

Fig. 1 is a faithful reproduction of a plot where was sown 18 oz. per acre of Superlative swede. No manure was sown with the seed, which was ridged in 26 in. rows. The land was in fair order at time of sowing, but a good deal of twitch was present, and this being a rather low part of the field the twitch, even though worked considerably, was not by any means eradicated, as can be seen. As previously indicated, owing to mistaken instructions this plot was never further cultivated, and when weighed in August last the crop yielded at the rate of only 7 tons 18 cwt. per acre, tops included.

Fig. 2 shows two rows (marked x x) of Superlative swede grown without manure in a straight-out manurial trial. It will be seen from the photo that a fair amount of twitch had been worked out of this piece of ground also, but that was the result of a thorough system of cultivation which provided for the scuffler going through once a month during the growing-period of the swedes. In spite of the fact that no manure was sown with the seed here, when the crop was weighed (same time as previously mentioned plot) in August last this plot yielded at the rate of 24 tons 9 cwt. to the acre, or 16½ tons more than the non-cultivated plot. As a matter of fact, the average yield in this series of the experiments, wherein slow-acting phosphatic manures were used, was just over 30 tons per acre, so that from all points of view it is evident that systematic cultivation plays an important part in the production of root crops.

On the one hand the gain of 16½ tons over the non-cultivated plot affords an example of labour being well rewarded, and on the other hand the loss of 6 tons per acre as against a manured and cultivated plot seems to just about assess the value of the fertilizer used. There is no doubt that crop-production can be increased enormously, providing a sound system of preparatory cultivation is followed up by as sound a system of subsequent intercultivation.

FIG. 1. SWEDE PLOT AT WINTON EXPERIMENTAL AREA, GROWN WITHOUT MANURE AND NOT INTERCULTIVATED. YIELD, 7 TONS 16 CWT. PER ACRE.

FIG. 2. TWO ROWS—MARKED X X—IN ANOTHER SWEDE PLOT ON THE AREA, ALSO GROWN WITHOUT MANURE, BUT INTERCULTIVATED. YIELD AT RATE OF 24 TONS 9 CWT. PER ACRE.

TESTING OF PUREBRED DAIRY COWS.

CURRENT C.O.R. LIST.

W. M. SINGLETON, Assistant Director of the Dairy Division.

ALTHOUGH not the final C.O.R. list for 1920, the present return shows the records of almost a hundred cows and heifers completed in December. The remaining records of the year are expected to be ready for the next issue of the *Journal*. As this list is so lengthy, comment on individual records is withheld, but it will be noticed that many excellent yields are reported.

RECORDS COMPLETED IN DECEMBER, 1920.

Name of Cow and Class.	Tested by	Age at starting Test.	Fat req'd. for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
	JERSEYS.					
Junior Two-year-old.		Yrs.dys.	lb.		lb.	lb.
Flirtation	S. B. Fairbrother, Kiritaki	1 344	240·5	365	9,034·4	492·31
Glenmore Flower ..	A. C. Lovelock, Woodville	2 71	247·6	365	8,070·6	470·17
Diadem	S. B. Fairbrother, Kiritaki	1 356	240·5	365	7,673·3	459·71
Roslyn Sweet Bonnie	James Harris, Bombay	1 360	240·5	362	6,863·4	414·60
Silver Choice ..	J. T. Belcher, Cardiff..	1 352	240·5	365	7,653·3	406·06
Jerseydale's Daphne	John Pettigrew, Pihama	1 331	240·5	365	6,453·5	366·32
Miro Meadows Luna	A. A. Ward, Miro ..	1 232	240·5	365	6,026·4	354·58
Belvedere Lynetta ..	E. B. Eagle, Greytown	1 352	240·5	365	5,607·2	338·93
Lady Polly ..	F. E. Day, Tamahere	2 80	248·5	363	6,483·7	328·11
Ophir	J. Rae, Taneatua ..	2 11	241·6	304	6,678·5	327·57
Rosy Creek Princess..	H. Wells, Hawera ..	2 39	244·4	336	6,274·6	306·87
May of O.K. ..	H. Wells, Hawera ..	2 36	244·1	365	5,323·6	302·35
Oakvale's Hope ..	J. G. Short, Fitzroy ..	1 310	240·5	320	5,282·0	277·48
Senior Two-year-old.						
Roslyn Favourite Flower	J. Harris, Bombay ..	2 110	251·5	365	10,069·6	609·14
Fairfield Dora ..	W. J. Chynoweth, Cambridge	2 351	275·6	365	7,437·6	438·62
Golden Sunlight ..	R. B. Godfrey, Eketahuna	2 329	273·4	335	8,158·2	434·83
Twylish Phantom ..	John Shaw, Clevedon	2 342	274·7	338	7,289·2	383·34
Turtledove ..	E. B. Eagle, Greytown	2 286	269·1	365	5,906·1	341·31
Fairy's Top ..	J. G. Short, Fitzroy ..	2 344	274·9	264	5,434·0	279·54
Three-year-old.						
Duchess of Woodstock	Banks and Son, Kiwitea	3 131	290·1	348	11,199·9	616·21
Cabaletta	H. R. Manning, Maharahara	3 38	280·8	349	10,700·8	566·87
Iona of Bulls ..	R. F. Wilkinson, Pukekohe	3 46	281·6	365	9,177·6	543·46
Beachland's Rose ..	A. C. Lovelock, Woodville	3 362	313·2	365	9,857·3	501·99
Middlewood's Lorna	S. R. Simkin, Karamea	3 20	279·0	365	9,399·7	493·61
Riverside Gem ..	J. T. Belcher, Cardiff..	3 346	311·6	365	8,065·0	492·18
Holly Bank Lady ..	Banks and Son, Kiwitea	3 305	307·5	365	8,442·2	485·25

LIST OF RECORDS—*continued.*

Name of Cow and Class.	Tested by	Age at starting Test.	Fat req'd. for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
	JERSEYS—*continued.*					
Three-year old—contd.		Yrs. dys.	lb.		lb.	lb.
Waipiko Bronze ..	H. A. Lurman, Otorohanga	3 34	280·4	343	6,720·0	461·68
Miro Meadows Maire	R. W. Southee, Kiwitea	3 319	308·9	365	7,901·7	453·27
Chartreuse ..	H. A. Lurman, Otorohanga	3 78	284·8	329	7,881·0	450·78
Fashionplate of Woodstock	Banks and Son, Kiwitea	3 46	281·6	364	7,974·4	420·23
Waipiko Leola ..	W. J. Chynoweth, Cambridge	3 4	277·4	344	6,253·2	402·22
Renown's Carnation	F. J. B. Ryburn, Paterangi	3 74	284·4	356	8,275·6	388·42
Violet Primrose ..	F. E. Day, Tamahere	3 51	282·1	365	7,905·4	348·52
Orielton Banksia	B. Tripp, Timaru ..	3 1	277·1	299	6,412·1	328·83
Heartsease of Sherwood	E. Hodges, Waimana	3 184	295·4	292	5,558·2	315·02
Four-year-old.						
Woodstock's Fancy Free	Banks and Son, Kiwitea	4 111	324·6	364	15,562·5	770·35
Middlewood's Fame..	S. R. Simkin, Karamea	4 22	315·7	365	9,138·3	468·92
Rose Maitland ..	A. Hazelton, Waihou	4 290	342·5	365	8,956·7	454·67
Mature.						
Sybil See	Banks and Son, Kiwitea	9 27	350·0	362	15,032·0	645·25
Darkie's Bell ..	S. B. Fairbrother, Kiritaki	5 196	350·0	365	12,699·7	632·98
Belmont Flower ..	A. C. Lovelock, Woodville	6 83	350·0	365	11,455·3	613·47
Magnet's Chum ..	V. W. Nowell, Hawera	6 11	350·0	365	9,010·1	568·80
Fox's Dot of Tahua..	P. J. Small, Kairanga	5 2	350·0	353	12,005·0	562·76
Peggy's Mahoe ..	D. P. F. Malone, Kaponga	5 329	350·0	365	8,328·3	544·07
Spec	A. J. Harris, Bombay	7 151	350·0	340	9,945·8	515·78
The Woodland's Belle	R. F. Wilkinson, Pukekohe	5 252	350·0	350	9,229·0	515·23
Miro Meadows Pride	A. A. Ward, Miro ..	5 62	350·0	365	9,172·5	513·82
Leta's Cassie ..	A. H. Guy, Mangatoki	5 86	350·0	330	7,774·8	442·85
Judy	R. W. Southee, Kiwitea	9 211	350·0	365	9,186·7	433·73
Roslyn Bonnie ..	W. G. Reece, Opotiki..	6 81	350·0	302	7,229·9	414·14
	FRIESIANS.					
Junior Two-year-old.						
RosaPosch of Oakview	H. R. Green, Kairanga	2 32	243·7	365	19,515·5	718·83
Monavale Freda de Kol	W. D. Hunt, Invercargill	2 144	254·9	365	12,201·6	543·83
Rosevale Queen Daphne	North and Sons, Omimi	2 104	250·9	365	13,120·7	509·82
Princess Pietertje de Kol II	R. Melvin, jun., Masterton	2 6	241·1	365	13,914·3	459·72
Midnight II ..	F. O. Stack, Kiwitea..	2 23	242·8	365	9,850·8	371·39
Pareora Guyda ..	A. S. Elworthy, Timaru	2 54	245·9	365	9,578·6	344·80
Pareora Alfiva ..	A. S. Elworthy, Timaru	2 1	240·6	365	8,941·8	326·55
Rowena II of Te Aroha	F. O. Stack, Kiwitea..	2 31	243·6	334	6,791·3	324·43
Karamea Duchess ..	D. McLeod, Wellington	1 355	240·5	331	8,556·5	315·51
Ellesmere Butterfly	T. H. Overton, Lakeside	2 47	245·2	210	8,811·7	304·84
Fairview Nellie Segis	Mrs. Hardwick, Kennington	2 65	247·0	326	8,759·3	293·87

LIST OF RECORDS—*continued.*

Name of Cow and Class.	Tested by	Age at starting Test.	Fat req'd. for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
	FRIESIANS—*continued.*					
Senior Two-year-old.		Yrs. dys.	lb.		lb.	lb.
Dominion Jocrest ..	Central Development Farm, Levin	2 276	268·1	357	15,294·7	539·00
Dominion Doreen II	Central Development Farm Levin	2 275	268·0	331	12,887·7	474·14
Dominion Marie Kruger	Central Development Farm, Levin	2 333	273·8	365	10,376·7	396·53
Dominion Olivia ..	Central Development Farm, Levin	2 253	265·8	365	10,625·5	345·36
Dominion Sadie Vale	Central Development Farm, Levin	2 298	270·3	330	9,517·7	322·93
Dominion Spot V ..	Central Development Farm, Levin	2 346	275·1	294	7,694·5	302·92
Junior Three-year-old.						
Segis Van Buttercup	R. Melvin, jun., Masterton	3 137	290·7	365	17,009·6	666·02
Dominion Johanna Aaggie	Central Development Farm, Levin	3 5	277·5	342	12,822·2	418·54
Senior Three-year-old.						
Rosevale Holland Lassie	North and Sons, Omimi	3 312	308·2	365	14,295·6	496·46
Duchess Netherland Pietertje	D. McLeod, Wellington	3 328	309·8	365	11,574·0	451·18
Netherland Gem ..	D. McLeod, Wellington	3 216	298·6	365	12,117·5	384·79
Junior Four-year-old.						
Cluny Hengerveld Buttercup	Cluny Farm, Wellington	4 50	318·5	292	14,191·6	508·36
Parthena Alcarta Rose	H. W. Hoskin, Mangatoki	4 23	315·8	365	14,189·8	494·52
Senior Four-year-old.						
Rosevale Holland Queen	North and Sons, Omimi	4 201	333·6	365	14,910·0	560·41
Milkmaid Patch ..	T. H. Overton, Lakeside	4 328	344·1	278	13,225·4	460·83
Mature.						
Segis Galatea ..	H. W. Hoskin, Mangatoki	6 3	350·0	365	18,166·1	647·82
Bainfield Queen ..	W. D. Hunt, Invercargill	5 220	350·0	365	17,128·6	601·89
Helena Plus Girl ..	North and Sons, Omimi	7 156	350·0	357	14,130·7	537·81
Mierlo	Central Development Farm, Levin	11 84	350·0	324	14,911·0	489·61
Woodcrest Daisy ..	Central Development Farm, Levin	8 102	350·0	359	14,872·2	481·89
Dominion Julia de Kol	Central Development Farm, Levin	6 63	350·0	334	12,703·5	401·20
Coldstream Grace ..	G. A. Marchant, Cardiff	10–11	350·0	218	10,460·5	401·05
Dominion Margosa ..	Central Development Farm, Levin	5 319	350·0	321	10,467·7	363·65
	MILKING SHORTHORNS.					
Junior Two-year-old.						
Matangi Ruth I ..	Ranstead Bros., Matangi	1 307	240·5	365	5,686·9	243·24

LIST OF RECORDS—*continued.*

Name of Cow and Class.	Tested by	Age at starting Test.	Fat req'd. for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
		MILKING SHORTHORNS—*continued.*				
Mature.		Yrs. dys.	lb.		lb.	lb.
Hill Holm Pet ..	A. Wintour, Te Rapa ..	..	350·0	365	16,180·7	581·50
Sherwood Queen ..	Mrs. Ranstead, Matangi	..	250·0	346	12,927·9	474·62
Sherwood Ruby ..	Mrs. Ranstead, Matangi	..	350·0	365	11,845·9	453·87
Greenfield Tottie ..	H. Campbell, Matangi	..	350·0	318	11,988·1	451·66
Sherwood Mystery ..	Mrs. Ranstead, Matangi	..	350·0	338	11,789·3	447·57
Greenfield Roany ..	H. Campbell, Matangi	..	350·0	325	12,040·3	444·43
Greenfield Fairy ..	H. Campbell, Matangi	..	350·0	363	11,698·6	441·49
Greenfield Flo ..	H. Campbell, Matangi	..	350·0	336	10,507·2	433·21
Greenfield Dot ..	H. Campbell, Matangi	..	350·0	322	10,429·9	426·30
Sherwood Peach ..	Mrs. Ranstead, Matangi	..	350·0	332	10,275·3	394·01
Sherwood Rose ..	Mrs. Ranstead, Matangi	5 19	350·0	347	9,742·7	353·63
	AYRSHIRES.					
Three-year-old.						
Greenfields Ina ..	C. E. C. Webb, Koputaroa	3 345	311·5	365	13,958·3	566·02
Mature.						
Milkmaid of Springview	A. H. Hansen, Te Rehunga	5 349	350·0	365	12,826·2	600·21

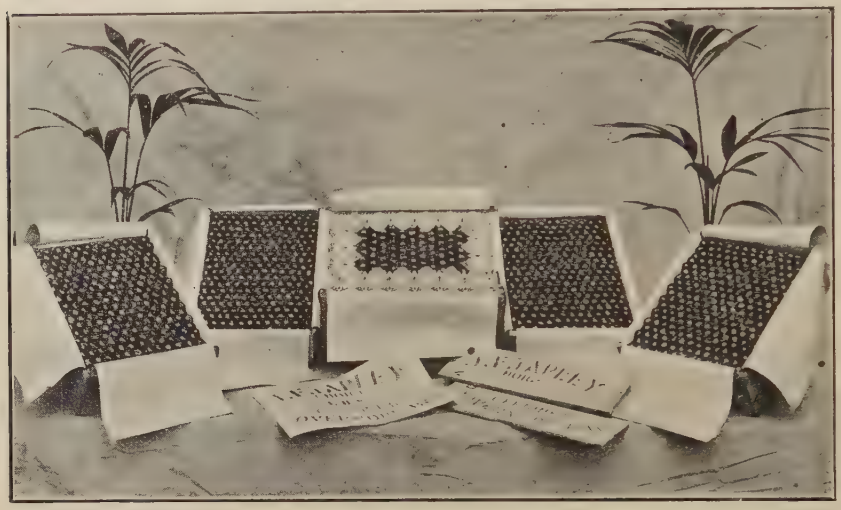
A NOTE ON CHERRIES IN CANTERBURY.

THE following information regarding cherries grown in the orchard of Mr. J. F. Tapley, Governor's Bay, Lyttelton Harbour, was supplied by Mr. G. Stratford, Orchard Instructor. The photograph on next page shows some of last season's pack:—

The cherries are put up in 12 lb. cases and faced. This is a decided improvement in the prevailing system of simply filling the cases with all sorts and sizes and sending to market. With the facing, grading has to be done, and consequently the face is a correct indication of the cherries throughout the case. The grower states that by adopting this method he has no difficulty in obtaining top prices on the market; his fruit sells very readily and advertises itself to the best advantage. A neatly printed "liner" is placed on the top of the fruit, adding much to the general get-up. The extra trouble taken is more than compensated for by the increased price obtained.

The cherries shown in the photo are from twelve-year-old trees growing in heavy loam topsoil, with a clay subsoil which is fairly free, although drainage is necessary to get the best results. The varieties are Early Rivers and California Advance, both of which do well in the Governor's Bay district. Other varieties grown are Early Purple Guigne, Bedford Prolific, Bigarreau Napoleon, Noble, Black Eagle, Warder's Early Black, and Monstrous De Mazel. Probably the most profitable is Bedford Prolific, which comes in for the Christmas market, is of large size, a good carrier, and a heavy bearer. Warder's Early Black, Early Rivers, California Advance, and Black Eagle are all worthy of

consideration as mid-season varieties if planting. Early Purple Guigne is undoubtedly a very fine cherry, and always commands a good price, but unfortunately it is very subject to dropping in this district. The Noble is a good cherry, but it is too late to realize high prices, while the Monstrous De Mazel up to the present has not proved itself a good bearer.



GRADED AND FACED CHERRIES FROM MR. TAPLEY'S ORCHARD, GOVERNOR'S BAY.

The Governor's Bay district is very suitable for the successful growing of cherries, and no doubt more will be planted as time goes on. Having such an excellent market—Christchurch—so close at hand, cherry-culture should prove a profitable investment.

GRIMM LUCERNE AT CHRISTCHURCH.

THE extraordinarily robust growth of a plant of Grimm lucerne selected by Mr. A. Macpherson, late Fields Instructor, Christchurch, has at various times been commented upon in the *Journal*, and a further note on the subject will doubtless be of interest. The plant made a continuous growth throughout the winter months of 1920. All the strong growths were cut away in September, and the fresh shoots made rapid headway, being quite 1 ft. in length within fourteen days after being cut. During November a second cut was secured. The average length was over 4 ft., and after being dried it was weighed and found to give 5¼ lb. of hay (from the one plant).

Judging by the vigorous growth of this selection of Grimm lucerne, 4,840 plants set out 3 ft. apart and 3 ft. between the rows would appear to be sufficient for 1 acre. This will be understood when the fact is mentioned that the plant when in full growth last season measured

12 ft. 9 in. in diameter. Taking the plant mentioned as a criterion, an acre of such plants would yield 11·3 tons of hay per acre for one cut. The plant actually gave five cuts last season, and the yields from each cut were approximately the same weight.

It may be mentioned that a plot of Grimm lucerne was sown at the Department's depot, Bath Street, Christchurch, in December, 1919. The plot is now twelve months old, and it is of interest to know that it has given four cuts in that time. The first was taken fourteen weeks after sowing, and the fourth on 6th December, 1920. The total yield of hay for the year from this plot, at a per-acre calculation, works out at 12¼ tons, which at £8 per ton (market value) gives the handsome return of £98 per acre per annum.—*R. McGillivray, Fields Instructor, Christchurch.*

FORTHCOMING AGRICULTURAL SHOWS.

Woodville A. and P. Association: Woodville, 25th and 26th January.
Helensville A. and P. Association: Helensville, 29th January.
Feilding I., A., and P. Association: Feilding, 1st and 2nd February.
Te Puke A. and P. Association: Te Puke, 3rd February.
Pahiatua A. and P. Association: Pahiatua, 4th February.
Clevedon A. and P. Association: Clevedon, 5th February.
Otago A. and P. Society: Dunedin, 9th and 10th February.
Dannevirke A. and P. Association: Dannevirke, 9th and 10th February.
Rodney Agricultural Society: Warkworth, 12th February.
Masterton A. and P. Association: Solway, Masterton, 15th and 16th February.
Northern Wairoa A. and P. Association: Aratapu, 19th February.
Omaha and Pakiri A. and P. Association: Leigh, 23rd February.
Franklin A. and P. Society: Pukekohe, 25th and 26th February.
Hauraki Plains A. and P. Association: Ngatea, 26th February.
Waikato Central Agricultural Association: Cambridge, 1st and 2nd March.
Egmont A. and P. Association: Hawera, 2nd and 3rd March.
Katikati A. and P. Association: Katikati, 3rd March.
Morrinsville A., P., and H. Society: Morrinsville, 9th March.
Matamata A. and P. Association: Matamata, 15th March.
Hawke's Bay A. and P. Society: Hastings, 15th and 16th March (Autumn Show).
Ashburton A. and P. Association: Ashburton, 17th March.
Mackenzie County A. and P. Society: Fairlie, 28th March.
Methven A. and P. Association: Methven, 31st March.
Mayfield A. and P. Association: Mayfield, 31st March.
Oxford A. and P. Association: Oxford, 7th April.
Temuka and Geraldine A. and P. Association: Temuka, 14th April.

WORK FOR THE COMING MONTH.

THE ORCHARD.

THE FIRE-BLIGHT CAMPAIGN.

THE fire-blight menace continues to be the most disturbing factor in fruitgrowing circles. Not only does this apply to the Auckland District, where the disease actually exists, but owing to its destructive nature and the probability of its sooner or later spreading farther afield growers of other districts are considerably alarmed. In the meantime the Auckland District growers have formed a strong Fire-blight Committee, and are generally adopting energetic measures with a view to coping with the trouble as effectively as possible.

The Department has still a strong staff of permanent and temporary officers in the field locating and cutting out infection wherever found. Owners of affected hawthorn hedges are under notice to eradicate the disease from such hedges before 31st March next. The preliminary step advised is to reduce all such hedges to a height of not more than 5 ft. Subsequently, if necessary, advice will be given as to the best means of dealing with affected parts still remaining.

Owing to the period between this and the end of March being recognized as a specially busy season for farmers, the shortage of labour is a factor which is fully recognized in connection with the cutting of hedges on the lines suggested. In view of this and the fact that the danger of further spread is limited until next spring, an extension of time will be granted in all genuine cases on application to the local Orchard Instructor, provided the applicant gives a definite undertaking to carry out the work and to destroy all prunings before the expiry of the extended period. The reason why the present date (31st March) is retained in preference to a general extension to June or July is owing to the impossibility of the limited number of Inspectors being able to adequately attend to the large area infected if the whole of the work is thrown on to the latter end of the safety period. This can be risked only in the event of the intention of the farmer being known, and the most satisfactory way of learning this is by the farmer lodging an application for extension, which will be granted provided he gives the undertaking previously referred to.

Judging from articles appearing in the Press there are a few fruitgrowers who are sceptical relative to the whole matter of fire-blight and the control measures. Theories put forward are various, but the trouble is mainly attributed to cold winds, weakness of the tree, lack of proper plant-food, &c. Statements have been made to the effect that a similar disease affected our orchards in different periods in the past and was only temporary in its effects, disappearing as quickly as it came, &c. These opinions would no doubt be very consoling if there were any hope of their being correct, but unfortunately there are none, consequently their expression is calculated to do a considerable amount of harm in connection with the fight which is being waged and which must be continued against this disease. There may have been infections in the past resembling fire-blight—in fact, there are still some—but despite this it is quite safe to say that the present fire-blight disease has never previously existed in New Zealand.

Although the disease is new to this country, through the medium of American literature on the subject, combined with over twelve months' practical local experience, its peculiarities have become well known to the officers of the Horticulture Division. There are, however, people who still appear to be in doubt as to whether fire-blight will actually kill trees or not. On this point there need be no doubt. Fire-blight will kill trees, and has already done so in New Zealand. Some trees are, of course, more resistant than others, but the hardiest of them are at least liable to be rendered more or less valueless from a fruit-producing point of view through blossom-infection, which is practically sure to take place any time the disease is allowed to be carried over from one season to the other in

their vicinity. The matters of weakness, strength, and cultural methods generally apparently play no part in the case. In America as well as New Zealand strong trees and weak trees alike, under practically every known condition, are equally readily affected.

It is not suggested that these and similar channels of investigation should be ignored, despite the non-success attending similar efforts elsewhere, but possibly a considerable amount of time would be required for their operation. If one's house were on fire it would be folly to stop to consider the installation of a high-pressure water-service if other means of fire-fighting were available. In a manner of speaking our New Zealand orchards are on fire, a portion has already been destroyed, and if we wish to prevent a general conflagration we must energetically adopt the only known means of prevention available. The only effective means to hand for the control of fire-blight—which is the form of "fire" referred to—is to cut out and destroy all infected parts, and to do this cutting-out so effectually as to prevent the disease being carried over to the following season either on fruit-trees or any other plant. Anything short of this will mean that fire-blight will be always with us.

—J. A. Campbell, Assistant Director of the Horticulture Division.

AUCKLAND.

Fire-blight: Since writing the orchard notes for last month an unlooked-for development has taken place in regard to this dread disease. Further infection has taken place in the inner suburban area of Auckland, and in the outer suburbs on the western side, reaching in this direction as far as the very borders of large commercial areas. From the time the infection took place early last season at Te Papapa the Department has adopted a vigorous policy of inspection and destruction of infected trees where necessary, with a view to limiting the infection to a definite area. This work is now being helped on by the honorary inspectors working under the Auckland Provincial Central Fire-blight Committee in conjunction with the Department in the commercial areas. However, the domestic orchardist and the general public may greatly assist by immediately reporting to the Orchard Instructor for their district any suspicious symptoms which may appear in their orchards from time to time. In view of the fact that hawthorn is a means of carrying over the disease from one season to another, all persons residing in the commercial fruitgrowing areas are asked to cut out their hawthorn wherever possible, in order to increase the possibility of successfully dealing with the disease in those areas. There is no other known method of successfully dealing with this disease than cutting out infected parts, and destroying the same by burning.

General operations: The most important routine operations for the month are cultivation and spraying. Citrus-growers who have so far been unable to get bordeaux on to their lemons at the falling of the blossom-petals from the main spring-crop flowering should lose no time in applying this at 4–4–40 strength, and in cases where verrucosis or grey scab is bad this spray should be repeated after about four weeks have elapsed.

Spraying summary: Peach, nectarine and plum—commercial lime-sulphur 1–125, or self-boiled lime-sulphur 8–8–50, when the fruit begins to ripen, and further as circumstances demand. Pear, apple, and quince—commercial lime-sulphur 33° test, 1–100, in conjunction with arsenate of lead, paste 1½ lb. or powder ¾ lb. to 50 gallons, every twenty-one days. To this may be added, if necessary, Blackleaf 40 at the rate of 1–800 for control of woolly aphis. Lemon and orange—bordeaux, 4–4–40, when petals have fallen from the main-crop blossoms (if not already applied). The commercial lime-sulphur application should be continued on pip-fruits wherever black-spot is showing. In cases where black aphis of the peach is giving trouble McDougall's Insecticide, 1–50, should be used. A second application may also be necessary to effectually control this insect.

—J. W. Collard, Orchard Instructor, Auckland.

HAWKE'S BAY.

A number of the various varieties will mature for picking in the immediate future, and care should be taken in the selection of fruits to pick. Immature fruits shrink badly soon after removal from the trees, while fruits allowed to remain on the tree to attain the maximum development and colour have a very short marketing-period, becoming overripe rapidly. Experiments have indicated that the best results can be obtained by picking only fruits which have a distinct

change of ground colour towards light yellow. This will necessitate going over the trees several times at intervals, but the uniformity of fruit marketed will well repay the extra care. Once fruit is picked it should be shaded from the direct sunlight as soon as possible, and stored or marketed without delay.

Little can be added to the spraying operations recommended last month, except to stress the necessity of keeping all pip-fruit covered with arsenate of lead, to meet the attack of the brood of codlin-moth which can be expected at this season of the year. —*W. H. Rice, Orchard Instructor, Hastings.*

NELSON.

With the month of February the apple harvest commences in earnest. Growers should therefore complete arrangements without delay and see that necessary supplies of packing-materials are on hand. Important modifications have been made in the export regulations regarding size and colour; these must be studied and the pickers instructed accordingly. Great economies can be made if the picking-teams are right. Teach them what to pick. Picking for export is by no means an easy job. While apples that are too small and immature must be left on the tree, *all* mature apples of sufficient colour must be gathered; any that are overlooked now and gathered later give no end of trouble if included in the pack. Apples below C grade should be placed in separate boxes by the pickers or placed in a heap at the butt of the tree; this precaution will save double handling later. As far as possible gather the fruit when it is cool, and place it in the shade.

Among the necessary improvements in the export pack are two very important ones. First, the box into which the goods are finally placed must be carefully examined before packing; a lot of fruit is lost for lack of this precaution. See that the box is strongly and well made. Put aside a doubtful box without hesitation. The second point is the matter of stencilling. Have you the right quantity of paint on your brush? Is that stencil straight and in the right place? Not only must stencils look well, but they must be very clear, and always in the same place. Nearly every time that fruit is handled those marks have to be read. Bad marking is not encouraging to a buyer.

Towards the end of the month autumn rains can be expected to commence, and spraying precautions must be renewed. Further application of lime-sulphur and arsenate of lead will be required.

Orchard cultivation generally should now cease. Where necessary a cover-crop can be sown now. The present time is more especially suitable for sowing lupins or peas. —*W. C. Hyde, Orchard Instructor, Nelson.*

CANTERBURY.

Spraying: The notes which appeared in the November *Journal* still hold good for both pip and stone fruits. At this period lime-sulphur may be applied at the strength of 1 in 120 on apples and pears. The second period of moth-infection may be expected about the third week of this month.

Reworking trees: The latter part of this month and February is a good time to bud to better varieties all poor and worthless kinds. Be sure the buds to be used are taken from trees known to produce a high-quality fruit. Insert the bud on the outer or underneath side of the limbs. Besides the bark lifting more easily, a better-shaped tree will be obtained than if the buds are inserted on the inside.

Summer thinning: Wherever trees are found to have too much growth throughout the centre, superfluous growths only may be cut to within six or seven buds from the base from which they spring. The leaders should not be touched. Heavy branches should not be cut at this time. Thinning should not be commenced until after the terminal buds have set. This will open up the centre of the tree and admit sunlight, which aids the development and ripening of wood and fruit-spurs.

Cover-crops: Growers intending to grow a crop between the trees for green-manuring purposes should order their seed so that it will be on hand when required.

Cultivation: The land should be given a thorough cultivation, so as to break any crust which may have formed and to check the growth of the weeds. Hand-hoeing should be done around the trees, so as to loosen the soil missed by the cultivator.

Marketing fruit: Care should be exercised that fruits are not allowed to become too ripe before being picked. The time to pick is one of the most

important problems in the successful marketing of fruit. With stone-fruits the degree of ripeness depends upon the distance from the markets. They should arrive on the market sufficiently firm to permit the retail fruiterer to hold them in good condition for from two to three days. Early apples are ready when they have attained full colour, and the fruit-stalk will readily part from the spur when the fruit is bent upwards with a slightly twisting motion. Early pears should be picked as soon as they have reached full size and before they begin to colour, and then the fruit-stalk readily parts from the spur. Both early apples and pears should be placed on the market without delay.

Fruit for identification: From time to time specimens of fruit are submitted for naming without any description of the habit or growth of the trees, or any particulars whatever. It is advisable that the specimens should be accompanied by a description of the tree; when the fruit ripens; the name, if any, which it is locally known by, and any other information which would be of assistance. At least three specimens (typical), with stems attached, should be sent.

—W. K. Dallas, Orchard Instructor, Christchurch.

OTAGO.

The reported prevalence of green aphis throughout Otago was not exaggerated. This disease has caused considerable damage to peach crops, especially early varieties, hundreds of trees being defoliated and defruited by its attacks. When trees become infested the first precaution must be to remove the tips of the shoots where infection is bad, and destroy by fire immediately, otherwise the insects will crawl back up the trees. Spray at once with Blackleaf 40 at 1–800, with 4 lb. of soap dissolved in each 100 gallons of spray-mixture. Watch the effect, and repeat the spraying if necessary.

Growers will be very busy marketing the stone-fruit crop at this time, but attention must be given to the necessary spraying to ensure this year's crop, and prepare for next year's also. Pests and diseases, such as woolly aphis and mildew, must be dealt with now, as next season's crops are dependent on the preservation of buds and laterals. Do not trust to luck; take practical measures by removing infected twigs and burning them. Spray well with Blackleaf 40 at 1–800 for woolly aphis. Use lime-sulphur at 1–120 for mildew if the weather is cool, but I strongly advise atomic sulphur at 8–10 lb. to 100 gallons of water under the present warm droughty conditions. Black-spot is in evidence; it is not serious at present, but growers are reminded that further infection is likely. If wet weather should set in careful watch should be kept, and lime-sulphur at 1–120 applied if the disease shows signs of further development. Spray again with arsenate of lead for codlin-moth, and also for cherry and pear slug if necessary.

Budding of fruit-trees can now be attended to where a change of variety is desired. Where grafting has been done during the dormant season the ties will need cutting. At the same time the new growths should be protected by tying, to prevent their being wrenched off by the wind.

—J. H. Thorp, Orchard Instructor, Dunedin.

THE GARDEN.

W. H. TAYLOR, Horticulturist.

VEGETABLE-CULTURE.

PLANTING and sowing for the winter supply should mostly be complete by this time. In the warmer districts cabbages, broccoli, brussels sprouts, savoys, and kale can be planted up to the middle of February. Any planted after that time are not likely to turn out first-rate. In the cooler districts celery should be all out before now, but in the warmer districts good results can be secured by planting much later.

Turnips should still be sown in small breadth, except swedes, which should be sown in breadth sufficient for winter use. French and butter beans may still be sown. Lettuce should be sown in drills, not to be transplanted. Water the seed in the drills before covering it up; it will be through the ground in about ten days; thin the plants as soon as they can be handled, and water as necessary. Silver-beet and spinach may be sown and treated in the same manner. The surface soil is usually dust-dry at this time of the year, and it is practically useless to sow small seeds without some provision for moisture.

Marrows, pumpkins, and other gourd plants are now running freely. The long vines should be stopped by cutting off the growing tips. It is quite common for the first fruits on these plants to fail to develop. That is because they usually come on the main runners, and the strength of growth prevents their development. The crop is mostly borne on side branches—laterals—and the object in stopping the long runners is to promote the growth of these fruit-bearing laterals. After the long runners have been stopped the growth of the plants is of a different character, and every growth is able to bear fruit.

Tomatoes: Strong growth is natural now, and all side shoots should be stopped as soon after they show as possible; a few days is sufficient to let them get away. Where the plants are growing in open situations, in not overrich soil, and are not watered much or at all, there is little fear of blight. But where they have been given a good deal of fertilizer, or other means taken to force growth, blight is always a danger, and spraying should not be neglected. Let it be of a preventive nature; it is a difficult matter to cure blight, though it may generally be prevented.

Asparagus: This, of course, is in full growth, cutting having long since ceased. If it is possible to give the plants an occasional dose of liquid manure it will do good. A light dressing of nitrate of soda is beneficial, and tends to keep the soil moist; 1 oz. per square yard may be given. The stronger the growth that is made during the next few months the better the next crop. Old beds become such a mass of growth, even when not planted closely, that wind does not affect the plants much. Young beds, however, are not so protected, and means should be taken to prevent the tops being blown off. Sometimes it is necessary to provide them with stakes, but in many cases it is quite sufficient to cut the tops off, so as to make them branch out. The different growths then become locked together and support each other. Topping the plants makes no difference in the total growth made, the side branches making greater development.

Rhubarb: No more stalks should be pulled from the summer varieties, but all the growth made after this time should be allowed to die down on the plants. Unless this is done the spring crop, which is the one of value, will not be worth anything.

Onions: At this stage no attempt should be made to force growth by feeding with liquid manure or fertilizer, as the result of such treatment might be to bring on a bad attack of mildew. Keep the soil free of weeds and the surface loose; this will be the best way to help the bulbs to ripen. In some places mildew comes almost as a matter of course—a climatic trouble that cannot be avoided. Early ripening is the best safeguard. Spraying is of use as a preventive of mildew, but once established the disease cannot be cured. To be effective the spray should be given at once, and it may be necessary to repeat it if rain occurs. Bordeaux mixture at 2–2–40 strength, or sulphide of potassium, 1 oz. in 3 gallons of water, may be used. The latter is the easiest to use, simply having to be mixed with cold water.

THE APIARY.

G. V. WESTBROOKE, Apiary Instructor.

THE EXTRACTING SEASON.

ALL preparations for the main extracting should now be complete. It is of great importance to see that the extractor is placed on a solid foundation and well fastened down by the stays provided. Where possible it is better to have the extractor on the floor in preference to a platform. The honey-house built on a hillside on the gravity system lends itself more readily to this method, and is preferred to any other system by those who have adopted it.

Where the contour of the land does not allow of this style of honey-house, the next best method is to make use of the honey-pump. Some beekeepers seem to have had difficulty in getting these to do the work, but it seems that the secret of success is to have a 1 in. pipe in place of the ¾ in. usually supplied, and also to see that there are no right angles in the piping. It is, however, very doubtful if these will do the work with thick honey.

In apiary work, as well as in all other occupations requiring the handling, packing, and marketing of foodstuffs, the question of cleanliness must not be lost sight of. Everything in the honey-house should be kept scrupulously clean. The

extractor and tanks should be scalded out previous to being used, and as soon as the day's work of extracting is done they should be covered with covers made for the purpose, so as to keep out all dust and vermin.

Removing Honey from the Hives.

As previously advised, see that the honey is well ripened before removing it. The usual method of removing honey from the hive for extraction is to take out the combs one by one, giving each comb a sharp shake to dislodge as many bees as possible, then give each side a light brush to remove those remaining. The frame of honey is then placed in an empty super or hive-body on the barrow, and taken to the honey-house. This method allows the combs to be examined, so as to reject any containing brood. But where queen-excluders have been in use the plan is usually to remove the queen-excluder the previous evening, slipping in its place a bee-escape board. As the bees go down through the escape during the night and are unable to return, this leaves the supers of honey clear of bees, and they can then be removed and placed on the barrow without the trouble of taking out each frame. The objection to this method, however, is that the honey is apt to become cold during the night, and so the work of extracting it is more difficult. This difficulty, however, is now overcome to a great extent by the use of the Hodgson ventilated escape-board, which allows the heat from the colony to pass up into the super, thus keeping the honey warm.

Extracting.

When sufficient honey has been removed to keep the extractor going for some time it is advisable to commence operations at once, while the honey is warm. Nearly all up-to-date apiaries are now equipped with a steam-heated uncapping-knife and capping-melters. There is no doubt that the use of these greatly facilitates the work of extracting.

Provision should be made to allow the honey to run from the extractor or pump through a strainer before it reaches the tank. It is a good plan to have a fairly coarse strainer on top to catch the larger particles of wax, and beneath it a finer one. For the lower one cheese-cloth answers the purpose very well. These strainers should be removed when necessary and washed in cold water, then given a good shake to remove the small particles of wax, and allowed to dry before again using.

From the strainer the honey should be run into tanks in order to allow it to settle and the small bubbles of air and particles of wax that have escaped the strainer to rise to the surface. These should be skimmed off as they accumulate.

The size of the tanks is a matter for the beekeeper's opinion, but the tendency now is to have deeper tanks sufficiently large to hold at least one day's extracting. The honey should be left in these for two or three days if the weather is good. Should the weather become damp during extracting the tanks should be kept covered so as to prevent the honey taking up moisture from the damp air. If it is found that the honey on the top is becoming thin it is advisable to skim this off and put it aside. No such honey should be put in packages for the market, otherwise it will probably mean a considerable loss, owing to fermentation setting up through the excessive moisture.

POULTRY-KEEPING.

F. C. BROWN, Chief Poultry Instructor.

THE GROWING STOCK.

FEBRUARY is more or less a slack period on the poultry plant. At the same time there are many things which will require attention if the stock are to be maintained in a healthy thriving state, and if the maximum profit is to be made from the business. The chief among these is to see that the growing pullets are managed to the very best advantage, as any neglect now will mean a set-back for life.

The aim of the poultryman should be to rear his birds in such a way that they will possess the desired size and constitutional vigour when the productive season arrives. With this end in view the birds should not be encouraged to lay before they are about six months old. The time when a pullet will commence to lay is largely influenced by the quality of the food supplied. Where rich foods, such as

meat, meat-meal, &c., are included in the ration, these have the effect of forcing the bird to lay at too early an age, with the result that she seldom grows to a desired size or lays a decent marketable egg. On the other hand, a ration consisting of good grain materials and a liberal supply of green food will tend towards encouraging growth, and not prematurity. Especially does this apply if a high percentage of good plump oats (preferably hulled) are included in the ration. Oats, providing they are of good quality, are an outstanding food for the growing pullet, while, on the other hand, inferior oats are next to useless for any class of poultry.

Of course, in all flocks some pullets will commence laying much sooner than others, even when a plain diet has been provided. In such cases it is a mistake to reduce the ration for the flock with a view to delaying the laying-period. The only safe course is to give the birds as much food as they can eat, and let nature take its course as to when the productive season commences. Generally speaking, the growing pullets require three good meals a day. As is the case with any class of live-stock, good and liberal feeding is one of the secrets in building up desired size and stamina.

Do not on any account neglect, if possible, to give the pullets a good range. The same may be said in regard to the cockerel intended for breeding purposes. It is essential that the birds be kept in the best of health at all times, and there is nothing more conducive to this than a good range, so that ample exercise may be secured. This should not be confused with the management of the cockerel being prepared for market, as confined quarters are essential if the greatest weight is to be put on in a minimum of time.

Never allow the young pullets of various ages and sizes to run together, as this tends against the younger members of the flock making good headway. It is always a wise course to grade young stock according to their age and size. Of course, there are wasters in every flock which are seldom or never worth troubling with. When these are detected they should be got rid of, as not only are they susceptible to all kinds of disease, but they rarely prove profitable to keep for egg-laying.

Always at this season of the year I receive many complaints regarding leg-weaknesses in half-grown cockerels. This trouble is usually due to insufficient exercise, caused usually by confining the birds in small runs, coops, &c. These conditions tend to overforce the body, which becomes too heavy for the legs to carry. Once a bird is affected in this way there is practically no cure. Prevention is the only way of dealing with this trouble, and the best preventive is to provide ample room for exercise. Many breeders, after selecting the most desirable cockerels for future breeding purposes, make a mistake by placing them in confined quarters with little more room than enough to turn in, usually with the result that the most promising male specimens lose the power of their limbs, and are finally sold as table birds. It cannot be emphasized too strongly that the cockerel intended for the breeding-pen should never be coddled, but, on the other hand, should rather be given the most natural conditions possible.

THE ADULT FLOCK.

The feeding of the adult flock is another matter calling for special attention at the present time. Hens it is intended to dispose of at the end of the present productive season should be provided with a forcing diet, in order that every available egg be secured before the birds are got rid of. On the other hand, birds it is intended to breed from next season should be given a plain diet, with a view to retarding egg-laying, so that their vitality will not be weakened when called upon to produce eggs for reproductive purposes.

A correspondent asks if it would be a wise course to encourage his hens to rest now with the hope of their laying better during the winter months. This I cannot recommend, as the less nature's course is interfered with the better. This brings to my mind the advice spread broadcast a few years ago that by giving a starvation ration and inducing a false moult the hens would lay right through the dear-egg season. It may have proved all right under special local conditions, but some breeders who tried it here found it to be all wrong. The birds moulted when it was desired, but they moulted again in the late autumn, which practically meant that neither autumn nor winter eggs were secured. For winter eggs there is no doubt that pullets, provided they are hatched out at the right time (say, September for the light breeds, and a month earlier for the heavier breeds), are the most desirable birds. Then, if the birds are not to be bred from, every available egg should be forced out of them until they prove unprofitable to keep, and this irrespective of the season and price of eggs.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

FLOWERING RAPE AND LIVE-STOCK.

J. M., Cheviot :—

I have a paddock of young grass showing a good deal of rape in flower. I am afraid to turn sheep on to it, as I know of sheep having been lost while grazing on flowering rape. Would it be safe to put cattle on it; or either sheep or cattle after the flowers are gone? There is plenty of young grass 8 in. or 9 in. high all over the paddock.

The Live-stock Division :—

Flowering rape or rape which has grown to seed is dangerous to both sheep and cattle when consumed in large quantities. Rape in this stage not only causes tympanites, or hoven, but also the acrid matter in the stems causes diarrhœa or scouring, which ultimately leads to chronic gastro-enteritis. Rape is more dangerous to stock when the seeds have formed, this is due to the oil, which resembles oil of mustard, which is very dangerous to animals either young or old. Neither cattle nor sheep are fond of eating flowering rape provided there is an abundance of other feed available. It would be extremely risky to turn cattle into a paddock where there is an abundance of flowering rape together with young grass 8 in. or 9 in. high. If it is essential to graze cattle on this paddock, half an hour a day would be the longest period cattle could be grazed, but even this might cause tympanites.

CONTROL OF WILD CONVOLVULUS.

Mrs. R. W. Kemp, Tokomaru Bay :—

Can you advise me how to kill wild convolvulus? Some time ago a small patch appeared in an enclosure always reserved for hay. It is increasing rapidly, and very soon there will be no grass left, as the weed seems to take possession and kill out the grass.

The Fields Instruction Branch :—

Wild convolvulus is very difficult to control. We would advise deep ploughing in the autumn and resowing at once with a good grass-mixture. If not convenient to plough and resow, top-dress with a good pasture top-dressing mixture at the rate of 3 cwt. per acre, and graze, refraining from cutting for hay for a couple of seasons.

PICKING AND STORING OF LEMONS.

"Amateur," New Plymouth :—

Would you kindly advise me as to the best time to gather lemons, and the method of storing them until fit for sale.

The Horticulture Division :—

Lemons should be gathered when they show the first sign of turning yellow. The fruit should be cut off with a portion of the strig and be most carefully handled, as the slightest bruise results in a lost lemon. The fruits should be allowed to stand for a few days in the boxes they were gathered in, then packed in paper-lined boxes or tins, or on trays in single layer, taking care that none are bruised. The boxes or trays may then be stacked in blocks in such a manner as to permit a free circulation of air round each case. This is most important, as it allows any surplus moisture to escape. The trays should be examined about every month or six weeks and any decaying fruits removed. The object is to reduce the thickness of the skin and increase juiciness.

TRIMMING COWS' TOES.

N. A. H., Westport :—

I have a cow, now in her second season, which has great difficulty in walking owing to the length of her feet. The toes are crossed and she walks on the back of the foot. Would you please advise me as to how they may be trimmed.

The Live-stock Division :—

The overgrowing of claws in cattle is very common where the animals are grazed on soft land. The part of the claw which is overgrown can be removed, there being a special instrument made for the purpose, failing the use of which, a pair of strong pruning-shears may be used. The cow must be fixed in a position so that the foot affected is easily manipulated, the leg fixed by a leg-rope to prevent the cow from kicking. A portion of the horn is severed from the end of the claw with the shears, care being taken that the claw is not severed too far back, or the sensitive tissues will be injured. There is another method, which can be carried out with a piece of board, a broad wood-chisel, and a mallet. The board is placed under the claw, and the chisel on the claw where it is intended to cut off some of the horn. With a sharp blow from the mallet the claws can be severed. The only difficulties are the kicking of the cow or the cutting of the claw too far back and severing the sensitive structures.

TAKING NUCLEI FROM HIVES.—ZINC QUEEN-EXCLUDERS.

"DRONE," Hawera :—

I would like advice as to the best time to take nuclei from hives of bees, consistent with keeping the latter up to full strength for the honey-flow. The nuclei are to form a reserve for a few extra colonies next season, and for replenishing any queen that may be necessary during the spring. Could you also inform me if zinc queen-excluders are a success ?

The Horticulture Division :—

Nuclei may be formed at any time of the season providing the colonies are strong enough to stand the loss of bees. Experience in Taranaki has proved that the best time to get queens mated is in the autumn—say, March—and the loss of bees at this period would not affect the honey crop, but the nucleus colonies must be provided with winter stores. Zinc queen-excluders are quite a success, the best results being obtained by their use after the swarming-period. Queen-excluders generally have a tendency to induce swarming, and as this feature is not desirable when a honey crop is aimed at their use before the swarming-period is over is not recommended.

GRASSING OF DAMP SHADY LIMESTONE COUNTRY.

GEO. T. WHITE, Waitomo Caves :—

I have on this section several acres of rich loose land, some fairly steep, upon which the ordinary English grasses, although they germinate well and thrive for a season, seem to subsequently die out. When first burned the land threw abundant feed, but the grass has become very sparse now and is giving place to chickweed, wineberry, and lawyers. The sole reason seems to be that it is very much shaded by limestone cliffs and faces south. The original bush consisted mostly of large ratas, kohekohe, mahoe, konini, mamaku, and supplejack Can you recommend any grass-mixture that will meet the circumstances ?

The Fields Instruction Branch :—

The following mixture is recommended for your country : 10 lb. perennial rye-grass, 10 lb. cocksfoot, 4 lb. crested dogstail, 2 lb. Poa pratensis, 2 lb. Poa trivialis, 3 lb. timothy, 2 lb. white clover, ½ lb. Lotus major, 2 lb. Lotus hispidus; total, 35½ lb. per acre. The permanent constituents in this mixture are more or less shade-endurers, and when once established should prove permanent. If the expense were not so great one would add more poa pratensis and lotus major to the mixture. In the grassing of this type of country in the past too much

consideration has been given towards producing early and rapid feed from the time of sowing, perennial and Italian rye-grass figuring largely in the mixture. These species have proved themselves time and time again to be only temporary on much of your type of steep hillside country, and their temporary nature manifests itself in two ways: firstly, in a direct loss of feed owing to their going out after the second year; and, secondly, in the depressing effect these rapidly establishing grasses have on the establishment of those permanent species which are slower to establish. On certain country where the natural vegetation is likely to reassert itself rapidly after the burn some consideration, of course, must be given in the mixture to quick-establishing grasses, in order that stock may be maintained on those areas to cope with this reappearing natural vegetation. The aim, however, should not be to produce temporary feed for the feed's sake, but should be towards the production of a pasture that will be permanent. This will not be attained by making rye-grass the main constituent of the mixture. Cocksfoot and crested dogstail should be permanent on your country, and these two grasses should form the main constituents. Where the land is steep, however, and where soil-creep is a factor, cocksfoot and dogstail will not be permanent unless bound, as it were, in a continuous sole, and for this purpose the addition of Poa pratensis is recommended. The mixture of Poa pratensis, however, on the damp, limestone country should throw quite an appreciable amount of feed, besides acting more or less mechanically in the binding of the turf. On poorer faces Chewings fescue and Danthonia pilosa may be used for the same purpose. English trefoil may do well on your country, and the addition of 2 lb. to at least a portion of your sowing would be quite worthy of a trial.

FOUNDER IN CATTLE.

"BUSH COCKY," Owaka:—

A yearling bullock belonging to my neighbour became foundered through eating frosted turnips, and though about half a dozen cattle-drenches were administered these did no good. The beast became thinner and went about on its knees until finally destroyed. Is there any cure for this trouble if taken when the first symptoms are observed?

The Live-stock Division:—

Founder, or inflammation of the sensitive structures within the walls of the hoofs, is not of frequent occurrence in cattle. Treatment consists of giving at first a smart purgative of from ½ lb. to 1½ lb. of sulphate of soda or Epsom salts, according to the size and age of the animal. This should be followed by 2-dram to 4-dram doses of salicylate of soda two or three times daily. Cold packs should be applied to the feet, or the animal made to stand in a stream of water having a soft bottom, such as clay. The administration to a yearling bullock of about half a dozen cattle-drenches, which may contain full doses of a drastic purgative, would tend to aggravate rather than relieve the condition.

APPLES IN POULTRY-MASH.

"POULTRY," Waihi:—

Can you tell me if windfall apples, boiled and mixed with pollard, would be injurious to ducks or fowls?

The Live-stock Division:—

We do not recommend the inclusion of boiled apples in the morning mash for either fowls or ducks, as they are apt to have an injurious effect. A few raw apples may be thrown to the hens to pick at, but otherwise the birds should not be compelled to eat them in order to secure a meal of other food in the mixture.

Unidentified Subscription.—Two postal notes for 2s. each, Nos. 478938 and 478939, issued at Auckland, 3/12/20, have been received, with address Glenfield, but without name. The sender should communicate with the Publisher.

REVIEW.

THE LAND LAWS OF NEW ZEALAND.

DIGEST OF THE LAND LAWS OF NEW ZEALAND: By W. R. Jourdain, Solicitor of the Supreme Court and Chief Clerk of the Lands and Survey Department. Government Printer, Wellington, 1920; royal 8vo., 233 pp.; 30s.

THE official agricultural and pastoral statistics show that there are some 81,000 occupiers of holdings above 1 acre throughout New Zealand. The annual returns of the Lands and Survey Department indicate that the Crown tenants number about 33,000, while advances have been made under the Discharged Soldiers Settlement Act to over 8,000 soldiers to enable them to acquire farms. It will be seen that the proportion of Crown tenants and soldier settlers in the total number of farmers is an extremely large one, and a knowledge of the land laws is therefore of special value to probably one-half of the farmers in the Dominion. The land laws, however, are at the present time so numerous and amended that it is difficult to find the whole of the law relating to any subject without a great deal of searching. A good summary in ready-reference form, therefore, cannot fail to save much time and trouble.

Mr. Jourdain's work, recently issued under the direction of the Minister of Lands, is a summary, under alphabetical headings, of the whole of the provisions of the Land Act, 1908; the Land for Settlements Act, 1908; the Land Laws Amendment Acts for 1912, 1913, 1914, 1915, 1917, 1918, and 1919; the Land for Settlements Administration Act, 1909; the Land Settlement Finance Act, 1909, and amendment of 1910; the Discharged Soldiers Act of 1915, and amendments of 1916, 1917, and 1919; the War Legislation Act (Part II), 1916; War Legislation Act (Part I), 1917 and 1918; the Public Reserves and Domains Act, 1908, and amendments of 1911, 1912, and 1914; the Education Reserves Act, 1908, and amendments of 1910, 1911, 1913, 1914, and 1915; the State Forests Act, 1908, and amendments; the Scenery Preservation Act, 1908, and amendments; together with references to numerous sections in thirty-eight other statutes. Nearly one hundred law cases are cited in the Digest as bearing upon the provisions of the Acts summarized, and many references and notes are given so as to elucidate the meaning of the sections quoted.

The Digest will therefore be of great service to solicitors, local bodies, returned soldiers' associations, Crown tenants, and the public generally, as forming a ready and complete compendium of the law relating to Crown land, endowments, reserves, and forests. Special attention may be drawn to the portions headed "Discharged Soldiers Settlement"; "Aliens, Acquisition of land by"; "Small Grazing-runs"; "Pastoral Runs"; and "Aggregation of Land," which deal in a comprehensive manner with the legislation on these matters. They are of particular interest at the present time.

The Digest reflects great credit upon its author, and is a gratifying example of the interest taken by public servants in the work allotted to them. Great care has evidently been taken in its compilation, and the fact that a copy was presented by the Minister of Lands to each member of the House of Representatives during last session is a good indication of the value placed upon it by the authorities.

Copies may be obtained from the Government Printer. We understand that only a limited number are now in stock.

Warts on Cattle and Horses.—A good method for removing warts from cattle and horses is to clip the warts off with a pair of flesh-scissors. When bleeding has stopped apply nitrate of silver to the place where the wart has been. Another method is to tie a cord tightly around the base of the wart and let the growth slough off. The ligature should be rendered aseptic before being applied.—*Live-stock Division.*

LAND FOR DISCHARGED SOLDIERS.

DURING the present month the following blocks are being opened for selection by discharged soldiers :—

Twenty-four sections in the Tokatoka Block, North Auckland, in areas ranging from 48 to 98 acres, comprising first-class drained swamp, and suitable for dairying and agriculture. Fourteen sections in the Homebush Settlement, near Gisborne, in areas ranging from 4 to 27 acres. Five sections in the Wither Settlement, near Blenheim, in areas ranging from 9 acres to 10 acres, suitable for agriculture and small holdings.

Huia Settlement, near Ohura, and the Karu Settlement, near Te Kuiti—the former comprising six lots in areas ranging from 288 to 333 acres, and the latter five lots in areas ranging from 242 acres to 408 acres—will be offered on 18th February. Bomford Settlement, in Marlborough, containing 133 acres, will be offered as one lot on 8th March. Pukemapou Settlement, in the Waikato, acquired from Mr. J. B. Hutchinson, is being opened in twelve lots on 21st February ; these sections consist of first-class dairying-country, in areas ranging from 70 to 151 acres.

A large number of miscellaneous sections are now to be advertised for selection by discharged soldiers, and particulars of these will be available shortly.

REPOROA SETTLEMENT.

Considerable interest attaches to the Reporoa Settlement, situated in the Waiotapu Valley, between Rotorua and Taupo, as being the first estate in the "pumice country" acquired by the Government for soldiers. The estate, containing 28,083 acres of freehold and 1,297 acres of leasehold, was purchased from Messrs. Stead and Richmond in April, 1919, and arrangements were made to push on with the necessary survey, drainage, grassing, and other works required to make it suitable for soldier settlement.

Two blocks in the settlement have already been prepared and opened for selection, as the drainage and other works were sufficiently advanced to let the men commence work on the ground. The first block, containing 2,070 acres, comprising twelve sections, was offered in May, 1920, and there was a very keen demand for the sections. The second block, comprising ten sections, containing 2,733 acres, was offered and taken up in December last. These blocks comprise some of the better parts of the drained swamp, and are excellent soils for any class of agricultural or pastoral industry. The growth of grass and clovers in summer is phenomenal, enabling ready provision of fodder necessary for winter. Generally speaking, the locality is a most healthy one.

Prior to the second block being opened the secretary of the Auckland Returned Soldiers' Association in a newspaper advertisement asked intending settlers to communicate with him before applying. This advertisement called forth a reply from the settlers who had already been allotted sections, stating that they were thoroughly satisfied with their prospects, and that prosperity awaited any young man who was fortunate enough to draw one of the sections, provided he was willing to work and to face difficulties at the start.

The Chief Land Drainage Engineer has already expended a large sum in drainage, grassing, and other works, and further authorizations will be issued as necessary. Ten thousand posts were purchased by the Lands Department and placed on the ground for distribution at cost price to the settlers to prevent any delay in the erection of their fencing.

An area of some 12,000 acres of the higher lands is to be handed over to the Forestry Department, and that Department's operations will be an advantage to the settlement in many ways.

Several of the settlers are milking herds of cows this season, cream being collected by lorry from Rotorua thrice weekly. Provision is also being made in the settlement for a dairy factory when considered advisable.

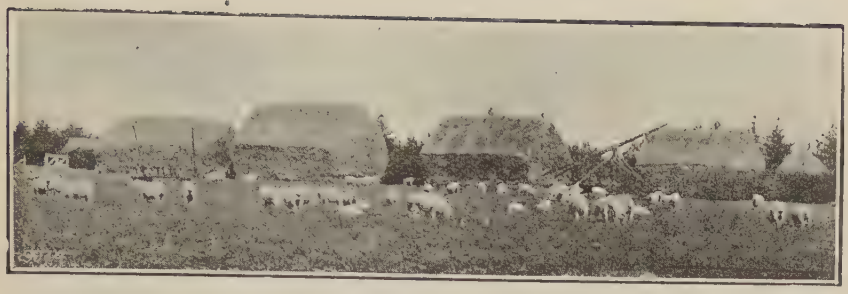
A factor which has operated to somewhat delay the final settlement of the whole block is that portions are interspersed with Native lands, the acquisition of which is being pushed on as expeditiously as circumstances will allow.

LIVE-STOCK IN NEW ZEALAND: 1920.

Unless otherwise specified, the enumeration is at 31st January, 1920.

Land District.	Horses.	Asses and Mules.	Cattle (including Dairy Cows).	Dairy Cows.		Number of Sheep shorn, 1919–20.	Number of Lambs tailed, 1919–20.	Sheep (including Lambs) as at 30th April, 1920.	Pigs.	Goats.	
				In Milk.	Dry.					Angora.	Other.
North Auckland ..	39,456	58	412,248	109,165	17,559	693,265	246,708	664,455	35,905	1,198	1,741
Auckland	49,702	15	617,261	178,661	27,989	982,252	391,598	911,135	52,423	570	1,249
Hawke's Bay	36,534	83	465,514	40,307	7,014	5,531,706	2,050,604	5,454,427	16,058	616	646
Taranaki	23,498	3	357,906	148,186	9,190	957,090	336,425	860,365	42,043	204	2,469
Wellington	47,687	30	615,633	124,230	17,530	5,132,461	2,096,032	5,358,289	39,751	924	642
Nelson	8,348	..	59,903	17,381	3,583	421,623	136,903	451,374	9,205	1,128	1,064
Marlborough	7,111	..	39,967	10,113	1,543	965,247	307,480	1,011,741	5,816	548	951
Westland	2,777	2	40,561	8,132	1,940	55,897	29,005	66,100	3,273	14	94
Canterbury	63,686	42	193,248	60,009	8,976	4,262,804	2,160,035	4,727,882	41,037	255	168
Otago	38,500	21	134,324	40,007	7,182	2,638,757	1,051,316	2,807,098	14,128	20	16
Southland	29,108	8	165,380	46,566	8,191	1,434,148	641,646	1,601,640	7,190	..	47
Totals for Dominion..	346,407	262	3,101,945	782,757	110,697	23,075,250	9,447,752	23,914,506	266,829	5,477	9,087
Totals, 1919 ..	363,188	296	3,035,478	732,253	93,882	23,720,818	10,485,351	25,828,554	235,347	6,446	10,478

[From Agricultural and Pastoral Statistics issued by the Government Statistician, gazetted 21st December, 1920.]



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TESTING OF PUREBRED DAIRY COWS.

THE NEW ZEALAND C.O.R. SYSTEM IN 1920.

W. M. SINGLETON, Assistant Director of the Dairy Division.

PERUSAL of the data included in this review and summary of the certificate-of-record testing of purebred dairy cows for the year 1920 cannot but be encouraging to those interested in the improvement of the Dominion's dairy cattle. The enterprise of the breeders in adopting to a larger extent the testing of their stock, together with a more general trend among dairymen to test their dairy herds on the association basis in greatly increased numbers, is conclusive evidence, on the one hand, that a wider appreciation is being shown of purebred stock, and, on the other hand, of the improvement of the herds by judicious culling.

During the season, according to the Statistician's figures, our dairy cows numbered 893,454. Dairy cattle have shown a progressive increase for years past, and such a position is additional evidence—if more were required—of the need of a greater number of purebred dairy stock. The small proportion of our total dairy cattle registered as purebred would suggest, however, that, despite the general increase in dairy stock, there is ample room for a very considerable develop-

ment in the number of purebreds. During the past year the tendency towards improvement in this respect, although more noticeable in the North Island, has been fairly general throughout dairying districts of the Dominion. As regards the testing of purebred dairy heifers and cows, Auckland Province has had the testing staff increased by two officers, Taranaki has an increase of two, and Wellington Province an increase of one, while the South Island has filled to overflowing the programmes of its testing officers. As a matter of fact, a few late entries from the South have had to be regretfully declined, owing to no testing officer being available at the time.

The testing officers doing the C.O.R. work have been called upon to do more association testing of ordinary dairy herds. Testing is being done by these officers for some thirty-two associations this season, as compared with twenty-two during the previous season. Later in the season requests were received for the formation of further associations, but these had to be declined or postponed—firstly, because satisfactory records could not be obtained with so late a start, and, secondly, because the officers' programmes had been already so filled as to make the additional undertaking impossible.

This enterprise on the part of breeders and dairymen points in the direction of a desire towards greater efficiency in many of the stud and ordinary herds of dairy cattle, and must ultimately prove to be in the best interests of the Dominion. It represents a praiseworthy effort to "increase production," and forms a portion of the dairyman's practical response to statesmen and economists who for some considerable time have been advocating this principle.

EXPORT OF DAIRY STOCK.

The conditions obtaining in New Zealand for handling dairy stock advantageously are so favourable that it was anticipated shortly after the C.O.R. testing system commenced that the production of some of our purebred dairy cows would be such as to attract buyers from outside New Zealand. A year ago we commented on the realization of this prospect, and the year under review has added further to the establishing of an export trade, which must be considered very satisfactory when the numbers of our purebreds are considered. The official figures show that during 1920 some 162 head of purebred dairy cattle were exported. Most of these animals went to Australia, Tasmania, and Java. We hope that at some time in the not distant future South Africa will also be among the countries to which New Zealand supplies purebred dairy stock, to the mutual advantage of both parts of the Empire.

ENCOURAGING THE USE OF PUREBRED DAIRY SIRES.

At the beginning of the current season an attempt was made by the testing officers to induce a number of dairymen to use purebred rather than mongrel bulls. The New Zealand Jersey Cattle Breeders' Association and the New Zealand Friesian Association expressed pleasure in granting the request of the Dairy Division for a supply of their Advanced Register of Merit and Year-book respectively. A number of these were forwarded to testing officers, the latter being requested to interview dairymen who were members of cow-testing associations

and who were using bulls that were not purebred. After getting an indication of the breed preferred by the herd-owner a copy of the booklet containing the records of that breed was left for further persual. It is pleasing to note that several dairymen were thus induced to use purebred rather than grade or crossbred sires.

Certain data have been collected which go to indicate that the progeny of a purebred bull from a certificate-of-record cow with a good production is likely when used in an ordinary dairy herd to sire daughters which will produce more butterfat than their dams. It is this fact we are endeavouring to get dairymen so convinced of that purebred bulls from C.O.R. cows will be used in an ever-increasing number of dairy herds.

CERTIFICATES ISSUED.

The number of certificates issued during 1920 shows a greater percentage of increase over the previous year than has occurred in any other year since 1914. A 44½-per-cent. increase is shown by a comparison of the number of ordinary first-class certificates. In addition to this number, some fifty-eight repeat first-class certificates were issued to animals which had previously qualified for the ordinary first class. The increase in repeat certificates represents 171 per cent. over the preceding year. The following table summarizes the results :—

Breed.	1913.	1914.		1915.		1916.		1917.		1918.		1919.		1920.	
		Ordinary.	Repeat.	Ordinary.	Repeat.	Ordinary.	Repeat.	Ordinary.	Repeat.	Ordinary.	Repeat.	Ordinary.	Repeat.	Ordinary.	Repeat.
Jersey ..	67	104	14	91	4	94	11	94	13	113	8	150	14	228	33
Friesian ..	48	67	11	62	9	44	5	62	14	57	14	54	7	82	23
Milking Shorthorn	..	..	..	2	..	7	..	21	..	22	..	53	3	59	2
Ayrshire ..	2	15	1	12	1	9	..	4	4	4	..	2	..	5	..
Totals ..	117	186	26	167	14	154	16	181	31	196	22	259	24	374	58

Second-class certificates have been issued on the records of some twelve Jerseys, one Friesian, and four Milking Shorthorns. This is the first year during which such certificates have been issued, and it is gratifying that the number represents such a small percentage of the total.

JERSEYS.

Class-leaders.

The list of Jersey class-leaders has been considerably changed during the past year, and in three of the five classes creditable increases have been established.

In the class under 2 years 93 days, Mere, who commenced her test at 1 year 346 days, has for quite a time held pride of place, but has now been displaced by Aster's August Child. The present class-leader commenced her test at the age of 1 year 337 days, and has

raised the class leadership by 25·41 lb. of butterfat. Breeders have every justification in feeling proud of such high records from the youngsters, provided such early mating be considered good policy.

The name of Lady Peggy has been under the notice of testing breeders since she established her first record. This year her leadership of the junior two-year-old class has been successfully challenged by Lady Superior, another New Plymouth cow, who has raised the class leadership by 30·83 lb. of fat.

Lady of Collingwood, like Lady Peggy, represented to a considerable extent the K.C.B. strain. She too has been defeated as class-leader in the four-year-olds. The new leader of this class is Woodstock's Fancy Free, who succeeded in raising the leadership by 34·28 lb. of fat.

The leader of the mature class, Sultan's Daisy, and the leader of the junior two-year-olds, Aster's August Child, are daughter and granddaughter respectively of Genoa Daisy. The leaders of the three-year-olds and of the four-year-olds are daughters of Fancy's Lord Twylish. Each of these two parents is therefore to be credited with a very considerable influence on the leadership of the classes, which now stands as follows :—

Name of Cow and Class.	Tested by	Age at starting Test.	Fat req'd. for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
		Y. dys.	lb.		lb.	lb.
Junior Two-year-old.						
Aster's August Child	James Nicolson, Kaupokonui	1 337	240·5	365	11,498·5	689·05
Senior Two-year-old.						
Lady Superior ..	John Hale, New Plymouth	2 183	258·8	365	9,975·5	680·33
Three-year old.						
Woodstock's Baby ..	Mrs. A. Banks and Son, Kiwitea	3 302	307·2	365	12,329·7	657·91
Four-year-old.						
Woodstock's Fancy Free	Mrs. A. Banks and Son, Kiwitea	4 111	324·6	364	15,562·5	770·35
Mature.						
Sultan's Daisy ..	E. O'Sullivan and Sons, Tariki	6 344	350·0	365	13,502·7	968·22

Class-averages.

The number of Jerseys tested during the year shows another increase, the highly satisfactory figure of 261 animals receiving certificates being attained. Without exception each class has been more strongly supported. The total certificates issued represents an increase of almost 60 per cent. on 1919.

With one exception the yield of the average animal in each class shows an increase. The class-averages are also progressive with the age of the animals. The comparatively strong support which each class has received doubtless tends in this direction.

WOODSTOCK'S FANCY FREE. (MRS. A. BANKS AND SON.)

Leader of the four-year-old Jerseys.

MAJESTY'S NEATHEAD. (S. R. LANCASTER.)

C.O.R.: 6 years 320 days; in 365 days, 10,667·75 lb. milk, 650·54 lb. butterfat.

The figures for 1919 and 1920 are as follows :—

Class.	Number of Cows.	Average Yield for Season.		
		Days in Milk.	Milk.	Fat.
	1920.		lb.	lb.
Junior two-year-old ..	78	344	6,701·3	370·96
Senior two-year-old ..	29	341	7,337·7	406·52
Three-year-old	52	339	7,836·3	432·64
Four-year-old	29	349	9,185·3	487·99
Mature	73	343	8,975·1	499·62
	1919.			
Junior two-year-old ..	62	343	6,579·0	369·93
Senior two-year-old ..	20	345	6,915·3	402·07
Three-year-old	27	337	7,815·4	442·42
Four-year-old	18	329	8,183·1	467·25
Mature	37	344	8,555·4	470·40

C.O.R. Bulls.

The list of Jersey bulls having C.O.R. daughters from as many as four different dams has been very considerably extended during 1920.

Name of Bull.	Total of C.O.R. Daughters.	Number of Daughters qualified during 1920.	Name of Bull.	Total of C.O.R. Daughters	Number of Daughters qualified during 1920.
Majesty's Fox ..	27	3	Stevenson	6	..
Eminent's Fontaine ..	25	3	Belvedere Sunset* ..	5	2
K.C.B.	25	3	Exile of Oaklands* ..	5†	5†
Roberts	17	2	Fancy's Carnation's Fox	5	1
Admiral of Puketapu	15	..	Farleigh Fox ..	5	1
Fancy's Lord Twylish	15	5	Good Luck ..	5	1
Bilberry's Goddington	12	3	Lord Lepperton ..	5	..
Campanile's Sultan ..	10	1	M.H.R.	5	..
M.L.C.	9	..	Marcus	5	1
Rozel's Sultan ..	9	..	Meadowbrook Nobility*	5	4
Starbright	9	..	Oculist XII* ..	5	1
Sunflower's Perseus ..	9	3	Silver King (Stuckey's)	5	..
Heather Boy* ..	8	5	The General* ..	5	3
Blizzard	7	..	Glory	4	..
Charm's Lord Twylish	7	1	Golden Fox II* ..	4	1
Frisky Campanile ..	7	1	Knight Commander ..	4	..
Goddington.. ..	7	1	Mona's Campanile* ..	4	1
Golden Swan ..	7	1	Nestor of Willowbank	4	..
Soumise Majesty ..	7	..	Noble Twylish* ..	4	3
Sunlight's Noble General	7	3	Oakvale's Red Line*..	4†	4†
Belvedere Butter Boy	6	1	Peggy's Campanile* ..	4	2
Brighton Twylish ..	6	1	Petune's Noble ..	4†	4†
Bush Boy	6	2	Renown of Meadow-brook*	4	3
Grand Duke ..	6	..	Silverlock's Duke ..	4	..
Lord Twylish* ..	6	4	Starlight II* ..	4	1
Mabel's Dairyman ..	6	..	The Squire (1272)* ..	4	1
Mermaid Sultan* ..	6	2	Yankee Sweet ..	4	0
Molina's General ..	6	..	Young Emperor III ..	4	..
Pride of Egmont ..	6	..			
Rainbow*	6	4			

* Qualified during 1920. † Also one second-class-certificate daughter.

No less than seventeen new bulls have qualified on the requirement, and this constitutes a development with which the Jersey breeders may well feel gratified. Last year's leaders are still in their old position, as each of the three at the head of the list have during the past year been credited with three more C.O.R. daughters.

Fancy's Lord Twylish had five daughters on test that received first certificates during the year. This is the maximum number that was added by any bull previously on the list, and the fact is the more pleasing in that a number of these records were of outstanding merit. The palm for highest-producing daughters goes to Sunflower's Perseus, who has five daughters which have more than doubled their requirement for certificate. These daughters are from different dams.

FRIESIANS.

Class-leaders.

The year has produced an alteration in the leadership of two classes, the same number as in 1919. The magnitude of the leadership records continues to increase, and it will be seen that now only one is below 700 lb. of butterfat.

ROSA POSCH OF OAKVIEW. (H. R. GREEN.)

Leader of the junior two-year-old Friesians.

The most manifest change has occurred in the junior two-year-olds, wherein Rosa Posch of Oakview succeeds as leader Princess Pietertje de Kol, with a comparatively wide margin of 92·01 lb. of butterfat. The

fact that the new leader commenced her work at the age of 2 years 32 days, as compared with the previous leader's start at 2 years 102 days, is also in favour of the new class-leader.

Netherland Princess IV is still a strong leader in the senior two-year-olds, a class which has produced nothing during the year which has seriously challenged this heifer's splendid record.

The junior three-year-old class has, however, witnessed a change in its premier cow. Segis van Buttercup has superseded as leader Rosevale Holland Queen, with a margin of 8·63 lb. of butterfat.

The leaders at the end of 1920 stand as follows:—

Name of Cow and Class.	Tested by	Age at starting Test.	Fat req'd. for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
Junior Two-year-old.		Y. dys.	lb.		lb.	lb.
Rosa Posch of Oakview	H. R. Green, Kairanga	2 32	243·7	365	19,515·5	718·83
Senior Two-year-old.						
Netherland Princess IV	John Donald, Westmere	2 341	274·6	365	19,621·6	805·77
Junior Three-year-old.						
Segis Van Buttercup	R. Melvin, jun., Masterton	3 137	290·7	365	17,009·6	666·02
Senior Three-year-old.						
Manor Beets Daughter II of Ashlynn	C. A. Hopping, Palmerston North	3 296	306·6	365	18,733·9	863·51
Junior Four-year-old.						
Westmere Princess Pietertje	John Donald, Westmere	4 156	329·1	365	24,199·0	939·78
Senior Four-year-old.						
Woodcrest Johanna Tehee	John Donald, Westmere	4 325	346·9	365	21,483·1	754·96
Mature.						
Burkeyje Sylvia Posch	H. North and Sons, Omimi	6 129	350·0	365	26,226·0	983·20

Class-averages.

The Friesian breeders have contributed a creditable increase in the number of cows and heifers tested and receiving certificates during the year. The increase represents some 65 per cent. in the number of certificates issued. The largest increases have been in the classes for junior two-year-olds and mature cows. This, of course, would be a natural expectation.

The class-averages vary from year to year to a degree that might not be expected. If a class contains a comparatively small number of C.O.R. animals one or more exceedingly good records have a marked influence on the class-average. The same result would be obtained were as many records comparatively low.

The average production for the mature class is an improvement on either of the two preceding years, despite the fact that the number of cows this year shows an increase.

The class-averages for the past two years are as follows:—

Class.	Number of Cows.	Average Yield for Season.		
		Days in Milk.	Milk.	Fat.
	1920.		lb.	lb.
Junior two-year-old ..	30	346	10,381·3	378·00
Senior two-year-old ..	12	349	11,741·6	421·95
Junior three-year-old ..	10	344	12,849·8	482·07
Senior three-year-old ..	11	359	12,456·2	448·99
Junior four-year-old ..	8	322	12,863·5	470·08
Senior four-year-old ..	6	341	16,068·7	565·68
Mature	28	339	14,938·9	531·06
	1919.			
Junior two-year-old ..	12	350	11,713·8	417·68
Senior two-year-old ..	11	358	13,393·1	482·24
Junior three-year-old ..	6	358	13,781·1	502·37
Senior three-year-old ..	4	327	12,154·3	410·00
Junior four-year-old ..	8	349	14,786·6	514·27
Senior four-year-old ..	2	287	13,150·5	468·57
Mature	18	334	15,064·0	523·59

SEGIS VAN BUTTERCUP. (R. MELVIN, JUN.)

Leader of the junior three-year-old Friesians.

C.O.R. Bulls.

Six Friesian bulls have been added to the list during the year, which is double the increase of the preceding year. Of bulls already on the list, the largest increase in the number of daughters receiving certificates during the year falls equally to King Segis Wild Rose Homestead and Woodcrest Hengerveld Mechthilde, both imported from North America. The present list retains Cliffside Laddie and King Segis Wild Rose Homestead at the top, with equal honours. The list stands as follows :—

Name o Bull.	Total of C.O.R. Daughters.	Number of Daughters qualified during 1920.	Name of Bull.	Total of C.O.R. Daughters.	Number of Daughters qualified during 1920.
Cliffside Laddie ..	19	2	Mutual Piebe of Rock	7	..
King Segis Wild Rose Homestead	19	4	Colonel Manor of Riverside	6	..
Sir de Kol Inka Pietertje	15	1	Longbeach Primrose League*	6	5
Kruger II ..	13	..	Oak de Kol II Homestead Fobes	6	1
Longbeach Van Tromp	11	1	Bainfield Dutchman*	5	2
Paul Pietertje ..	11	2	Colantha Johanna Lad	5	..
De Kol Pontiac Burke	10	2	Dom. de Kol Domino	5	..
Grace's Netherland of Riverside	10	..	King of Dominos ..	5	1
King Fayne Segis II. .	10	2	Woodcrest Joe* ..	5	2
Nazli de Kol ..	10	..	Bainfield Prince* ..	4	1
Prince Pietje Paxton	10	1	Longbeach Dutchman	4	..
Mutual Piebe de Kol	9	..	Netherland King ..	4	..
Woodcrest Hengerveld Mechthilde	9	4	Netherland King of Rosevale*	4	1
Edinglassie ..	7	..	Pietertje Boy ..	4	..
			Rozine's Butter Boy*	4	1

* Qualified during 1920.

MILKING SHORTHORNS.

Class-leaders.

At the request of the Milking Shorthorn Cattle Breeders' Association the classes for immature animals have been subdivided into junior and senior. This classification recognizes junior two-year-olds as being not more than 2 years 183 days of age on the day of calving for commencement of test. Senior two-year-olds are over this age and under three years of age at calving for start of test. A similar line of demarcation divides the junior and senior three-year-olds and four-year-olds.

The new classification brings forward the names of three more class-leaders than appeared in the review a year ago. Only two of the 1919 leaders retain their position. Joyce II of Hillview has been displaced as leader of the senior two-year-olds by Birkland Dainty, with a wide margin. In senior three-year-olds Dominion Daphne V has been superseded, with a margin of 150 lb. of butterfat, by Terrace View Rosy II.

The class-leaders for 1920 stand as follows :—

Name of Cow and Class.	Tested by	Age at starting Test.	Fat req'd. for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
		Y. dys.	lb.		lb.	lb.
Junior Two-year-old.						
Alice of Dungiven ..	W. Brady, Hukanui ..	1 355	240·5	365	7,476·1	318·30
Senior Two-year-old.						
Birkland Dainty ..	G. N. Bell, Palmerston ton North	2 281	268·6	365	11,616·9	459·98
Junior Three-year-old.						
Matangi Nancy ..	Ranstead Bros., Matangi	3 9	277·9	365	10,795·4	399·63
Senior Three-year-old.						
Terrace View Rosy II	T. De la Haye, Ngawapurua	3 360	313·0	365	13,270·8	577·00
Junior Four-year-old.						
Matangi Jewel ..	Ranstead Bros., Matangi	4 6	314·1	365	12,524·4	509·45
Senior Four-year-old.						
Matangi Strawberry II	Ranstead Bros., Matangi	4 351	349·6	365	12,774·6	473·50
Mature.						
Willowbank Beauty	S. G. Morgan, Ngawapurua	*	350·0	365	15,725·8	655·22

* Mature.

Class-averages.

As was the case during 1919, the mature class of this breed was comparatively strongly supported during 1920. The average production of this class shows an increase over that of the previous year, which is the more pleasing inasmuch as the number of cows in the class evidenced a 20-per-cent. increase.

The total number of cows tested and granted certificates is slightly in excess of that of the preceding year, but it will be noted that the increase in the mature class more than accounts for the total increase.

The data respecting the classes are as follows :—

Class.	Number of Cows.	Average Yield for Season.		
		Days in Milk.	Milk.	Fat.
			lb.	lb.
Junior two-year-old ..	4	360	6,540·2	275·46
Senior two-year-old ..	2	352	10,557·1	419·45
Junior three-year-old ..	3	365	10,028·4	380·87
Senior three-year-old ..	1	365	13,270·8	577·00
Junior four-year-old ..	2	365	11,651·5	497·91
Senior four-year-old ..	1	365	12,057·0	427·59
Mature	48	340	11,591·5	449·10

AYRSHIRES.

Class-leaders.

Quite a change has occurred in the class-leadership of the Ayrshires during the period under review. A larger percentage of the class-leaders have been altered than is the case in any other breed. Considering the small number of animals under test, the testing breeders representing this breed have accomplished praiseworthy results.

The two-year-old class is now headed by Greenfield's Sprightly II, who increases Kanadale Linda's record by 5·32 lb. fat. In the three-year-old class Greenfield's Ina has displaced Bluebell of Riverside by a creditable margin of some 40 lb. of fat. Both of the new class-leaders are owned and tested by Mr. C. E. C. Webb, of Koputaroa.

Alexandra of Waipapa has not yet been displaced in the four-year-old class, but her record as a mature cow has been relegated to second place by Milkmaid of Springview, who now takes the place of leader with the respectable margin of about 18 lb. of butterfat. The new leader was owned and tested by Mr. A. H. Hansen, of Te Rehunga.

The leaders now are as follows :—

Name of Cow and Class.	Tested by	Age at starting Test.	Fat req'd. for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
		Y. dys.	lb.		lb.	lb.
Two-year-old.						
Greenfields Sprightly II	C. E. C. Webb, Koputaroa	2 335	274·0	365	13,598·6	507·87
Three-year-old.						
Greenfields Ina ..	C. E. C. Webb, Koputaroa	3 345	311·5	365	13,958·3	566·02
Four-year-old.						
Alexandra of Waipapa	F. Mills, Waipapa, Hawera	4 348	348·3	365	14,348·6	591·16
Mature.						
Milkmaid of Springview	A. H. Hansen, Te Rehunga	5 349	350·0	365	12,826·2	600·21

APPRECIATION.

The increase in the number of testing breeders and animals tested has caused more work for the secretaries of the respective cattle-breeders' associations. To these secretaries for their enthusiastic assistance, and the association executives which have co-operated with the Division, we desire to indicate our hearty appreciation.

CLOSING LIST OF RECORDS FOR 1920.

The appended list completes the publication of records of all certificates issued during the calendar year 1920. A list of cows receiving second-class certificates, together with their records, is subjoined. It will be noticed that these lists record some excellent performances.

CLOSING LIST OF RECORDS.

Name of Cow and Class.	Tested by	Age at starting Test.	Fat req'd for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
JERSEYS.						
		Y. dys.	lb.		lb.	lb.
Junior Two-year-old.						
Pattern's Maid ..	C. H. Weston, New Plymouth	2 92	249·7	365	9,588·2	484·62
Jerseydale's Princess May	J. Pettigrew, Pihama	2 9	241·4	365	7,792·5	407·13
Clydesdale's Red Widow	G. Rae McKenzie, Carnarvon	1 345	240·5	365	6,993·9	344·94
Clydesdale's Bonny Maid	G. Rae McKenzie, Carnarvon	2 1	240·6	365	6,121·1	336·55
Oakden Rosette ..	T. A. Sowman, Auckland	2 58	246·3	331	4,861·4	269·86
Three-year-old.						
Apex Queen ..	R. Harper, Otorohanga	3 26	279·6	365	7,357·6	429·87
Belvedere Silver Dot	E. L. Roose, Pukekohe	3 264	303·4	365	7,866·7	420·80
Jerseydale's Coquette	J. Pettigrew, Pihama	3 63	283·3	365	7·037·0	413·43
Waipiko Chrissie ..	C. G. C. Dermer, Waipiko	3 346	311·6	197	7,094·6	346·63
Belle of O.K. ..	A. B. Robertson, Hawera	3 343	311·3	306	6,160·8	317·94
Oakland's Fancy ..	R. C. Leach, Woodville	3 16	278·6	253	5,155·6	291·80
Four-year-old.						
Myrtle's Bounty ..	H. Hall, Feilding ..	4 297	343·2	365	9,656·4	536·50
Lady Gloria ..	F. J. B. Ryburn, Paterangi	4 120	325·5	365	7,312·0	393·72
Fox's Vega's Maid ..	H. J. Berry, Kaupokonui	4 2	313·7	337	6,222·9	347·75
Mature.						
Waipiko Girlie ..	S. R. Lancaster, Palmerston North	6 27	350·0	362	8,614·2	592·84
Martha	H. C. Sampson, Hillsborough	7 356	350·0	364	9,717·4	497·29
Lady Beth ..	A. B. Robertson, Hawera	5 349	350·0	365	7,954·8	443·10
Oakden Nell ..	T. A. Sowman, Auckland	5 12	350·0	359	6,682·3	383·66
Queen Regnant ..	H. E. B. Watson, Fendalton	8 299	350·0	256	6,503·8	364·12
FRIESIANS.						
Junior Two-year-old.						
Woodcrest Ida ..	Borstal Institution, Invercargill	2 136	254·1	365	14,351·0	541·28
Rosevale Nancy Posch	H. North and Sons, Omimi	2 40	244·5	365	16,477·4	529·45
Pareora Groa ..	A. S. Elworthy, Timaru	2 90	249·5	365	10,326·3	406·05
Fairview Netherland Queen	Mrs. T. E. F. Hardwick, Kennington	2 95	250·0	314	11,372·5	395·13
Lakeview Rosa Belle Fobes	Bloomfield Farm Co., Wellington	2 34	243·9	365	7,475·9	274·98
Lakeview Nazline Kroons	Bloomfield Farm Co., Wellington	2 97	250·2	341	7,505·1	272·36
Lakeview Mercedes Burke	Bloomfield Farm Co., Wellington	2 107	251·2	359	6,617·2	255·13
Senior Two-year-old.						
Bainfield No. 19 ..	W. D. Hunt, Invercargill	2 241	264·6	365	13,870·2	481·59

CLOSING LIST OF RECORDS—*continued.*

Name of Cow and Class.	Tested by	Age at starting Test.	Fat req'd. for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
FRIESIANS—*continued.*						
		Y. dys.	lb.		lb.	lb.
Junior Three-year-old.						
Bainfield No. 11 ..	W. D. Hunt, Invercargill	3 51	282·1	365	15,097·8	581·20
Bainfield No. 12 ..	W. D. Hunt, Invercargill	3 19	278·9	365	10,279·8	453·91
Friesland Segis Lass	A. S. Elworthy, Timaru	3 69	283·9	365	10,964·9	430·42
Senior Three-year-old.						
Oakwood Gipsy Queen	W. D. Hunt, Invercargill	3 359	312·9	365	14,682·0	545·49
Bainfield I ..	J. Dow, jun., Outram	3 338	310·8	337	11,324·9	400·04
Junior Four-year-old.						
Bainfield No. 2 ..	W. D. Hunt, Invercargill	4 44	317·9	365	20,506·2	709·69
Dominion Anemone	Central Development Farm, Weraroa	4 49	318·4	291	11,429·0	402·99
Colantha Lass of Groteholm	R. M. Taiaroa, Taumutu	4 63	319·8	319	9,391·2	350·78
Senior Four-year-old.						
Domino Colantha Cadilac	W. I. Lovelock, Palmerston North	4 292	342·7	365	18,696·7	647·94
Rosevale Colantha ..	H. North and Sons, Omimi	4 237	337·2	365	18,113·3	627·17
Mature.						
Domino's Friesland Belle	W. I. Lovelock, Palmerston North	7 42	350·0	365	19,630·0	724·16
Bounty Maid Segis ..	R. Mugford, Spreydon	6 293	350·3	360	16,290·8	532·60
Oakwood Gowan ..	W. D. Hunt, Invercargill	6 36	350·0	365	15,130·6	508·06
Laddie's Gem ..	N. P. Nielsen, Palmerston North	8 355	350·0	365	14,265·7	494·65
Dominion Jessie Fobes Beets	Central Development Farm, Weraroa	9 193	350·0	297	12,091·5	415·56
Pietje Woodcrest Vernon	Cluny Friesian Farm Co., Wellington	8 203	350·0	337	12,147·8	381·80
MILKING SHORTHORNS.						
Junior Two-year-old.						
Matangi Ruth I ..	Ranstead Bros., Matangi	1 307	240·5	365	5,686·9	243·24
Senior Two-year-old.						
Birkland Dainty ..	G. N. Bell, Palmerston North	2 281	268·6	365	11,616·9	459·98
Junior Three-year-old.						
Dominion Pretty Princess of Weraroa	Ruakura Farm of Instruction	3 0	277·0	365	10,350·8	397·58
Junior Four-year-old.						
Dominion Perfect of Ruakura	Ruakura Farm of Instruction	4 77	321·2	365	10,778·6	486·37
Mature.						
Pitlochie Queenie ..	G. N. Bell, Palmerston North	..	350·0	365	14,670·5	568·87
Birkland Dot ..	G. N. Bell, Palmerston North	..	350·0	365	14,769·5	536·83

FOX'S LADY. (W. A. GUY.)

C.O.R.: 4 years 332 days; in 325 days, 11,192·7 lb. milk, 605·65 lb. butterfat.

WOODCREST IDA. (BORSTAL INSTITUTION, INVERCARGILL.)

C.O.R.: 2 years 136 days; in 365 days, 14,351 lb. milk, 541·78 lb. butterfat.

CLOSING LIST OF RECORDS—*continued.*

Name of Cow and Class.	Tested by	Age at starting Test.	Fat req'd. for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
	MILKING SHORTHORNS—*continued.*					
Mature—continued.		Y. dys.	lb.		lb.	lb.
Vale Royal Duchess	J. L. Turnbull, Christchurch	..	350·0	359	11,941·7	450·97
Bushby Park Beauty	Samuel Lye, Newstead	..	350·0	329	11,852·9	428·40
Dominion Bertha IV	Ruakura Farm of Instruction	..	350·0	329	10,508·1	413·58
Pride of Cornwall Park	R. V. Brown, Weraroa	6 35	350·0	312	9,913·9	362·60

SECOND-CLASS CERTIFICATES.

JERSEYS.

Junior Two-year-old.							
Craigie Lassie ..	A. L. Hooper, Mahoe..	2 20	242·5	365	7,993·5	479·34
Petune's Granny ..	H. C. Sampson, Hillsborough	2 3	240·8	365	8,200·2	428·58
Neat Victorine ..	S. R. Lancaster, Palmerston North	2 38	244·3	365	6,100·5	355·67
Oakvale's Margaret..	E. M. Fowler, Waitara	2 13	241·8	332	5,729·0	318·12
Four-year-old.							
Hazeline Chase ..	S. V. Barriball, Waiuku	4 350	348·5	365	7,604·2	376·37
Mature.							
Yellow Iris ..	P. J. Small, Kairanga	7 53	350·0	365	10,423·0	603·83
Melia Ann's St. Helena	H. C. Sampson, Hillsborough	5 297	350·0	365	9,709·7	556·89
Mountain View's Bessie	S. R. Simkin, Karamea	5 0	350·0	365	9,139·7	482·57
	FRIESIANS.						
Junior Two-year-old.							
Coldstream Colantha Pietertje	G. A. Marchant and Sons, Cardiff	1 344	240·5	365	15,034·1	521·16
	MILKING SHORTHORNS.						
Junior Two-year-old.							
Matangi Kate ..	Ranstead Bros., Matangi	1 325	240·5	365	5,577·9	280·50
Senior Two-year-old.							
Dominion Princess Daphne	Ruakura Farm of Instruction	2 309	271·4	365	11,745·4	399·64
Three-year-old.							
Pukerimu Roany IV	John Fisher, Pukerimu	3 21	279·1	359	7,639·0	300·91

Teachers' Farm-school at Ruakura.—This school, which has now become an annual fixture, was held from 24th to 28th of last month. A good course of lectures and demonstrations was carried out under very favourable weather conditions, with a full attendance of teachers, and the school as a whole was a distinct success.

PHORMIUM TENAX.

THE NEW ZEALAND FIBRE INDUSTRY.

ESMOND H. ATKINSON, Biological Laboratory, Wellington.

I. HISTORICAL.

THE first account of phormium* of which there is any record occurs in the journal kept by Cook of his voyage to the Southern Seas in 1768–71. After speaking of the paucity of useful plants in New Zealand other than indigenous timber-trees, he writes (in March, 1770): "There is, however, a plant that serves the inhabitants instead of hemp or flax, which excels all that are put to the same purposes in other countries. Of this plant there are two sorts; the leaves of both resemble those of flags, but the flowers are smaller and their clusters more numerous; in one kind they are yellow, and in the other a deep red.† Of the leaves of these plants with very little preparation they make their common apparel; and of these they also make their strings, lines, and cordage, for every purpose, which are so much stronger than anything we make with hemp that they will not bear a comparison. From the same plant, by another preparation, they draw long slender fibres which shine like silk, and are as white as snow; of these, which are also surprisingly strong, the finer clothes are made; and of the leaves, without any other preparation than splitting them into proper breadths and tying the strips together, they make their fishing-nets, some of which, as I have before remarked, are of enormous size. A plant which, with such advantages, might be applied to so many useful and important purposes would certainly be a great acquisition to England, where it would probably thrive with very little trouble, as it seems to be hardy, and to affect no particular soil, being found equally in hill and valley, in the driest mould and the deepest bogs; the bog, however, it seems to prefer, as near such places we observed it to be larger than elsewhere." In his second voyage (1772–75) Cook records the plant from Norfolk Island, with the remark that it appeared more luxuriant than in New Zealand; and in 1777 he gives a further account of its occurrence in this country.

Seeds were brought back to England by Banks, the botanist who accompanied Cook, but they failed to grow. However, in 1789 he brought back further seeds, from which the plant was successfully established at Kew and distributed from thence to many parts of Europe. These cultivated plants were almost certainly not *Phormium tenax*, but *Phormium Colensoi*.

* The term "phormium" will be used throughout this series of articles. Unfortunately, confusion exists in the nomenclature of the plant and its fibre—"flax" having become the popular and commonly accepted name, while "hemp" was adopted officially for the fibre in connection with grading, &c. Strictly speaking, neither of these terms is exact, the former applying to *Linum* and the latter to another European fibre *(Cannabis)*.

† Judging by his remarks on the colour of the flowers, &c., the two sorts mentioned by Cook probably refer to the two species *P. tenax* and *P. Colensoi*.

Later on, Labillardière, one of the naturalists accompanying the French expedition of 1791–92 sent out to search for the ill-fated La Pérouse, gave a more detailed account of the plant than had previously been published. Subsequent visitors to New Zealand soon discovered that its value was universally appreciated by the Maoris, who sometimes cultivated it beside their pas, and that, as well as employing the leaves in the various ways described by Cook, they used the gum which is exuded at the base of the leaf for food, and the flower-stalks for tinder and many other purposes, while the nectar was eaten by the children.

THE GENESIS OF THE FIBRE INDUSTRY.

Before the end of the eighteenth century whalers had begun to visit New Zealand, traders from Sydney, N.S.W., followed them, and by 1828 a considerable trade existed in phormium, fibre to the value of £50,000 being sold in Sydney alone between 1828 and 1832. One of the first shipments to England was in 1818, when 60 tons, valued at £2,600, were sent there from Sydney.

Early in the nineteenth century experiments were carried out in the English dockyards with a view to ascertaining the suitability of phormium-fibre for ropes, &c., with results that were said to be satisfactory, though the evidence on this point was rather contradictory. The probable reason for this lay in the methods employed in preparing the fibre. Originally all that was exported was dressed by the Maoris by a process which produced fibre of the very best quality, but which was very slow and laborious. This original Maori process was imitated and modified by the whalers and traders, who for the most part were unskilled and careless, with the result that a great deal of poor fibre found its way on to the market.

In 1830, 1,062 tons of fibre were exported, of which it was estimated that less than half was produced by the Maoris. It is recorded that a London merchant writing to his Sydney house in the same year urged the necessity of cleaning the fibre thoroughly, as much that had reached England was so poor in quality that the rope-workers would not work it up, even at increased wages. In spite of this, phormium gradually established its reputation on the English market, as is shown by the fact that while in 1820 it was scarcely possible to obtain £10 to £15 per ton for it, in 1830 it took precedence over Russian and Hungarian hemp at prices ranging from £30 to £40 per ton. The ease with which these great profits were made had the bad effect, however, of making the exporters think that any rubbish was sure of a ready sale in England, with the result that in a single year the price fell 50 per cent., and it was not until after 1870 that the export rose to its value of 1830, though other factors beside the slump in the English market were responsible for this.

In 1832 a manufactory was established at Grimsby, in Lincolnshire, for the production of articles from the fibre, but for some unexplained reason it did not succeed. Failure also attended the efforts of another company floated in England in 1844, which sent out hand machines and workmen to Nelson. The machines proved quite inadequate for the work, and though thousands of pounds were spent and other machines tried the results were no better. It was thought that the failure in this case was due to the fact that the fibre differed widely from any other on the market, and that it was not produced in

sufficient quantities to build up a position for itself on its own merits. Although many tentative efforts were made from time to time to invent a process which should be capable of producing good-quality fibre in large quantities, nothing of any real practical importance was devised, and up to the year 1860 all fibre was hand-dressed.

From 1832 to 1853 the statistics show a poor but fluctuating trade. From the latter year to 1860 the average annual value of the fibre exported was £2,500, reaching a maximum of £5,500 in 1855.

PHORMIUM TENAX IN A MANAWATU SWAMP.

THE MAORI WAR AND THE INTRODUCTION OF MACHINERY.

The outbreak of the Maori War in 1860 prevented trade production by the Natives, except those north of Auckland, with the result that from 1860 to 1866 the value of the fibre exported averaged only £180 per annum. The consequence of this was that renewed

attention was directed to the necessity of discovering a quick and reliable process of preparing the fibre. The methods proposed up to this time consisted in crushing the leaves between rollers, and then boiling them in alkaline solutions and thoroughly washing the resulting fibre. In 1861 Messrs. Purchas and Ninnis patented a machine which introduced percussion instead of rolling and did away with the washing in alkaline solutions. This was an important step, as it resulted in the production of a fibre very similar to manila in general appearance, and as the supply of the latter was at this time very limited there was a rise in the value of phormium from £21 to £56 per ton, and up to £76 per ton in America during the Civil War.

From 1861 onwards many new types of machines for dressing phormium were evolved, and in consequence the export of fibre increased rapidly. The yearly average value between 1866 and 1871 was £56,000, the highest figures being for 1870, when the value reached £132,578. Notwithstanding the apparent prosperity of the industry, the most contradictory opinions were held about phormium in respect to the preparation of the fibre, its manufacture, and markets, and in 1869 and the following year Commissioners were appointed by the Government to inquire fully into the subject.

In 1871–72 the name of the fibre on the English market was altered from "New Zealand flax" to "New Zealand hemp," with favourable results. The early years of this decade saw the greatest boom the industry had known, which reached its climax in 1873, when 300 mills, employing 3,200 hands and producing fibre of the value of £140,000 annually, were at work. But it was short-lived, for in 1874 there began a depression which lasted for fifteen years.

Although the export figures for this period of prosperity look large, there was very little permanent capital in the industry, which was largely in the hands of men who were content to put up a rough, slipshod mill in a suitable locality, work out the surrounding phormium areas, and when the supply was exhausted move on to a fresh place. Millers of this type were really the worst enemies of the industry, for their methods were quite reckless, everything being cut out regardless of its suitability, while most of them took no cognizance of the fact that the quality of the fibre obtained from different areas was liable to very great variation. The result of this was that the reputation gained by the fibre obtained from good-quality areas was often adversely affected by the appearance in the market of that obtained from poor-quality areas.

From 1890 for some years onward the industry was not in a flourishing state, and in 1894 it was reported to be almost at a standstill. A bonus of £1,750 for improvement in fibre-production, together with a further one of £250 for suggestions as to the utilization of the by-products, was offered by the Government, but though the offer remained open for a number of years and many improvements were evolved, chiefly by millers themselves, no complete award was made.

THE GRADING-SYSTEM.

It was about this time that the millers and merchants first began to realize that it would be in their own interests to have all fibre graded before export, and this feeling was emphasized by the report

of a delegate who had been sent to make an extensive investigation into the future prospects of the phormium trade in Britain, the Continent of Europe, and America. He stated on his return in 1899 that if the industry was to survive and grow into one of importance the establishment of compulsory grading of all exported fibre was essential.

Meanwhile, as a result of the Spanish-American War of 1898 and the consequent shortage of manila-fibre, there was a decided revival in prices for phormium; and this opportunity of securing a larger market also showed the necessity for grading, as it was obvious that only the best of our fibre could compete with manila, and that any adulteration of the superior grades with poor fibre would be fatal to success.

It was in May, 1901, that a grader was established in Wellington. The examination of phormium by him was not compulsory, but in spite of many objections that the standard of grading was too high a number of the better-class millers made use of his services. However, within a very short time the Flax Grading and Export Act, 1901, was passed, providing for the compulsory grading of all phormium exported, and a decided improvement was almost at once noticeable in the quality of the fibre shipped. Two years later the provisions of this measure were incorporated in the Products Export Act, 1903, which enactment shared in the consolidation of 1908.

The next few years marked a period of great prosperity in the industry, which was undoubtedly largely due to the higher standard demanded from the millers by the grading regulations, and by the consequent efforts on their part and also on the part of several of the leading engineering firms of the country towards the production of more efficient machinery. Notwithstanding this, however, the graders had repeatedly to report defects in manufacture, most of which were due less to inadequacies in the milling plants than to want of care or skill among the mill employees. These criticisms seldom applied to the better-class millers, many of whom had been producing fibre of high quality years before the grading regulations came into force, and who were quick to see any possibilities of reform that suggested themselves. At this period in different parts of the country there were signs of awakening interest regarding the cultivation of phormium, with a view to the conservation of future supplies of the raw material.

LATER DEVELOPMENTS.

In the New Zealand International Exhibition of 1907, held at Christchurch, there were fine displays of phormium, showing the fibre in its various stages of preparation and the uses to which it could be put, which indicated vividly the great possibilities lying before the industry.

During the following year two instructors in milling were appointed by the Government, their duties being to work in conjunction with the graders in pointing out to the producers any defects in the preparation of the fibre. The same year (1908) also saw considerable alterations in the grading regulations. A serious decrease in production was recorded at this time in consequence of an extreme depression in prices, the reason lying in the abundance of manila and in the low prices ruling for it, while the high royalties agreed upon during the previous years of prosperity were against profitable working.

The fall in values had the effect of bringing about a reconsideration of the royalties paid by millers to the owners of phormium, so that the former were less likely to suffer as a consequence of any future depression.

Tow-grading regulations were brought into force early in 1909, resulting in a great improvement in the quality of the tow exported.

Although the industry during these and the following years suffered both from fluctuating prices in the world's markets and from the spread of certain insects and diseases of phormium, some of which had begun to assume a serious aspect, the improvement of milling processes and the confidence inspired by the adoption of Government grading made the industry better able to withstand such vicissitudes of fortune than at any other time in its history. Notwithstanding the many improvements in fibre-extracting machinery which had from time to time been suggested and adopted, the millers themselves were the first to realize how much remained to be done in this direction, and in 1911 the New Zealand Flax-millers' Association approached the Government on the subject, with the result that a bonus of £12,000 was offered for improvements in the various processes. The bonus remained on offer for several years, but nothing of any radical importance was evolved, and many important problems in this direction still await solution.

Fibres were in great demand during the Great War, and the quantities of phormium exported approximated to the highest previously reached (roughly, 28,000 tons in 1907 and in 1913). The prices ruling for phormium during the war were greatly in excess of any previously known (except those during the American Civil War), averaging £53 per ton f.o.b. in 1918, as much as £70 per ton having been paid during part of this time.

Within the last few years a serious menace to the industry has appeared in the shape of a disease of doubtful origin known as "yellow-leaf." Though not always fatal, yellow-leaf has greatly reduced the yield of many previously flourishing areas, and the combating of this disease is perhaps the greatest problem confronting the miller of to-day. The matter will be further dealt with in a subsequent article of this series.

(To be continued.)

Carbon Bisulphide.—Since the publication of the article "Carbon Bisulphide for Rabbit-poisoning," in the *Journal* for January, 1920, inquiries have been made by the Department as to the possibility of establishing in New Zealand a small manufacturing plant for the production (by Taylor's patent electrical process) of local requirements, which were estimated as not exceeding 30 tons per annum. A communication recently received by the Department's Chemist from Messrs. Moses, Pope, and Messer, consulting engineers, of New York, seems to dispose of any such plan. They state that it would be commercially impracticable to build an electric furnace of the Taylor type to manufacture carbon bisulphide in amounts of only 30 tons per year, and that the smallest furnace in existence makes more than 12 tons per day.

FORESTRY IN NEW ZEALAND.

THE GOVERNMENT POLICY AND PRIVATE PLANTING.

L. MACINTOSH ELLIS, Director of the State Forest Service.

THE problem of the development of forest policy in New Zealand is of peculiar interest to the farmers and settlers, for the success or otherwise of a forward policy vitally depends on their interest and participation in the growing and harvesting of timber-trees. To emphasize this more clearly I shall briefly indicate and outline in what manner co-ordination of effort could assist us to obtain our objective—*i.e.*, the assurance of adequate timber-supplies at a reasonable price now and in perpetuity.

At the present time the world's visible supply of timber useful in the arts is limited, and all facts point to the absolute need of New Zealand solving the problem of future timber-supplies within her own shores, The responsibility is fairly ours. We must either go without essential timber-supplies, to the great hazard of our national safety, and perhaps with certain sacrifice of our industrial prosperity, or we must take immediate steps to assure ourselves an adequate supply of home-grown timber, which is perfectly practicable to-day.

A review of all existing estimates of the quantity of milling-timber available in New Zealand indicates an apparent volume of over 35,000,000,000 superficial feet, growing on about 8,000,000 acres. I am satisfied, however, that a careful survey and inventory of the resources will considerably increase this forest capital. While this quantity appears large, it will nevertheless require very careful husbanding and the introduction of considerable economies without delay if serious hardships are to be avoided in the near future.

The ownership of forests carries with it an obligation on the part of the State to see that mountains and plains are not laid waste, because forests affect fundamentally the economic welfare of communities and the nation. It is therefore right that in the liquidation of this great timber reserve the State should impose those silvicultural rules and manufacturing regulations which will ensure efficient conversion and clean utilization.

Under the forward forest policy of the Government during the past two years the total area of Crown forest dedicated permanently and provisionally for applied forestry management has reached 7,000,000 acres; and it is hoped that during the next four years this will be steadily added to by proclamation and purchase, until the total area of supply, protection, and recreation forests reaches 12,000,000 acres.

The primary objective of the forest policy of the Government is the assurance of adequate timber-supplies at a reasonable price for all time, and the protection and beneficial utilization of the forest resources of New Zealand for the people of the Dominion. Consequently it is necessary that an immediate and comprehensive investigation be made of our virgin timber resources, in order that this forest principle may

be subjected to an orderly and regulated forest management. This administration will have for its objective the continuous production of wood crops on a sustained-cut basis.

Doubtless many will say that it is impossible to regenerate our native trees, or that the rate of their growth is so slow as to be prohibitive. But whatever may be the case, the Forest Service is going to investigate and ascertain these matters once and for all, and before very long we hope to be able to present *facts* and not *opinions*. In any case, the forest capital is the main thing. Using the native forest as capital, it is possible to build on it, or its foundation, a consciously managed forest capable of annually producing its harvest of mature timber.

In the meantime it behoves the instrument of policy, the State Forest Service, to act as careful and honest stewards, rendering to the owners—the people of New Zealand—a strict account of their stewardship. This alone is a grave responsibility, and one attended with many difficulties.

The next five years will be the critical formative period. Many mistakes doubtless will be made, for until the fundamental knowledge of the laws of native-tree growth are obtained we are groping in the dark. Forestry is also hampered here through lack of trained men, but with the establishment of educational facilities I hope that technical foresters will be available in three or four years. In the meantime it will be our duty to place our house in order by inducing cleaner methods of utilization, preventing forest-fires, and educating the public as to the wealth of their valuable heritage, the forests of New Zealand.

As a basis for discussion, I estimate that our annual timber-consumption will be, within a generation, 1,000,000,000 superficial feet; and from what information is available I submit that the national requirements may be satisfied as follows: (1) The State indigenous forests, under scientific management, will produce 60 per cent. of the requirements; (2) the State-planted forests, under scientific management, 10 per cent.; and (3) private forests, shelter-belts, wood-lots, and importations, 30 per cent.

It is presumed in the case of (1) that a satisfactory stable forest capital has been secured and that an effective plan of management will operate.

With reference to (2), the State plantations by the period specified should be producing from 65,000,000 to 100,000,000 superficial feet of timber per annum.

Item (3) is the one of peculiar interest to settlers. It is generally accepted in professional circles that timber-growing is the proper function of the State, but in New Zealand an exception may be made to this general rule. The extraordinarily long growing season and the remarkably sustained performance of many exotic trees result in really wonderful returns. Where else in the world are better wood-yields obtained than here, where from 75,000 to 200,000 superficial feet per acre are secured for a thirty-year rotation of *Pinus insignis*? I challenge the production abroad of better results than have been obtained in such State plantations as those of Rotorua and Hanmer Springs. There are, indeed, many other similar examples, too numerous to mention, in New Zealand.

Therefore—to revert to my premise—in New Zealand the growing of forest-trees for profit by the individual is a sound and remunerative business. I am satisfied that with persistent presentation of the facts and the profitableness of the business a large and growing interest will be taken by farmers, settlers, local bodies, private companies, and syndicates in systematic planting.

To satisfy our future internal demands there is required in New Zealand an aggregate private area of 150,000 to 200,000 acres of plantations. Is it possible to induce the establishment of this big cumulative area within a generation? It is well worth trying for. Keeping continually at it by lecture, demonstration, education, and instruction, supported by reasonably priced planting-stock, expert advice, and the development of co-operative profit-sharing schemes, should result in the establishment and operation of thousands of small and large plantations throughout the Dominion.

Taxation could be adjusted to encourage planting, while forest-fire protection methods must be developed and forest-fire insurance perfected, so that every farmer will have his wood-lot, and from it secure a periodic and satisfactory return of timber for his own use and a steady profit by conversion.

In conclusion, I should like to state that the State Forest Service is out to be the leader in forestry matters in New Zealand. Constructive criticism is welcomed, for by that means the needs and requirements of all may be most efficiently satisfied. Moreover, the settler's forestry problems are our problems, and at all times the facilities and experience of the State Forest Service are at the disposal of would-be planters of trees in the Dominion.

The Khapra Beetle and Australian Wheat.—It is reported from Australia that the khapra beetle, a pest originating from India, has been found in wheat stacked at Enfield. The khapra is said to operate on dry grain, whereas the ordinary weevil does not attack grain containing less than 10 per cent. of moisture. The following note on the subject is supplied by Mr. A. H. Cockayne, Biologist to the Department: "*Trogoderma khapra* is an Indian dermestid beetle injurious to stored seed of almost any kind. The finding of the Imperial (War) Commission on cereal storage was that the only satisfactory method of dealing with this pest, and incidentally with weevils and other injurious insects, was airtight storage. Some doubt has been expressed regarding the efficacy of this treatment; but most failures can be traced to inefficient sealing. Carbon dioxide may be used successfully, but owing to the production of the gas by the so-called respiration of the grain and by the insects themselves it is unnecessary to introduce it into hermetically sealed granaries. At normal temperatures even mites (*Tyroglyphus longior*) were found dead after twenty-four hours' sealing. The great point to note is that the receptacles must be *full* of grain in order to keep the air-space as low as possible. Both heating and the growth of moulds are prevented by airtight storage."

PHORMIUM TENAX AS A FARM CROP.

GREAT POTENTIALITIES.

ALFRED SEIFERT, Palmerston North.

It is unfortunate that farmers have not yet realized what an extremely valuable plant we have in our New Zealand flax (*Phormium tenax*). I am confident that suitable land growing phormium systematically will yield a greater return than when used for any other method of farming that can be carried on in a fairly large way. I am looking forward to the day when New Zealand will export an average of 50,000 tons of phormium-fibre per year. This quantity of hemp could be produced from about 47,000 acres of land.

The following I consider to be a fair comparative statement of the returns from land growing flax and from the same class of land used for dairying. The statement shows the returns based on the highest and the average prices of hemp and dairy-produce during the last ten years :—

Return from 100 Acres growing Flax.

	Sold at Highest Price during Last Ten Years, £3 per Ton Royalty.	Sold at Average Price, £1 per Ton Royalty.
	£ s. d.	£ s. d.
Flax-leaf sold on royalty, 900 tons	2,700 0 0	900 0 0
Additional if flax cut and delivered to a mill by grower	900 0 0	900 0 0
Totals	£3,600 0 0	£1,800 0 0

Return from 100 Acres used for Dairying.

	Sold at 2s. 6d. per Pound for Butterfat plus 3d. for By-products.	Sold at 1s. 3d. per Pound for Butterfat plus 3d. for By-products.
	£ s. d.	£ s. d.
Return to landowner (less amount for share milking) at 140 lb. of butterfat per acre ..	1,284 0 0	700 0 0
Amount for share milking	641 0 0	350 0 0
Totals	£1,925 0 0	£1,050 0 0

These figures show that if the respective produce is sold at the highest figure obtaining during the last ten years the return per annum for 100 acres growing flax will be £3,600 if the flax is cut and delivered to a mill by the grower, while the return from 100 acres used for dairying will be £1,925. The labour involved in cutting and delivering the flax will be just about equal to the labour of dairying.

A crop of flax could be first cut in four years, providing it was properly planted, and thereafter every three or four years. The labour and expense of planting it would be less than that of planting potatoes. The flax plantation could be lightly grazed by young stock during the summer months. After each cutting the soil should be fertilized with some suitable manure. The crop would also be benefited if a

cultivator were run up and down between the rows for the first two years after the leaf was cut.

It must be recognized that the labour of cutting and handling planted flax would be much less than doing the same work in the present flax areas. In the first place, the flax would be in rows, and the bottom would be good for those engaged in the work of cutting and carrying the flax to where it could be taken away, whereas where the flax has grown naturally there is no system or order in the planting and the surface is often uneven, which makes work difficult. When we consider the returns from land growing flax, and the little labour required to keep the crop in order, it is evident that farmers who have suitable land near a mill or railway-station would be well advised to plant an area for their own benefit as well as that of the Dominion. The crop would afford some relief from the labour of dairying. The flax could be planted in such a way that it would provide shelter, which all agree is so necessary for stock.

Before farmers can be expected to plant for commercial purposes they must naturally be satisfied that a fair price will be paid for the flax they grow. I have gone carefully into market prospects, and have no hesitation in giving a decided opinion that hemp will continue to be sold at a payable price in the future. Lean years must be expected, but against these others will be exceptionally good and will fully compensate for the former.

The following are some of the reasons why we should be optimistic about the future of the hemp-market: The area planted in sisal in Yucatan, Mexico, is reported to have dropped 20 per cent. in the last three or four years. In German East Africa all the sisal plantations have run out, no planting having been done since the war commenced. The sisal-plant will live only about seven years in that climate. The first two years are taken for the plant to mature, for the remainder of the period the leaves are cut annually. When we consider that 30,000 tons of sisal-fibre were shipped in one year before the war it is easy to understand that the fibre from this part had a considerable effect on the market. The only place where the area in sisal has increased is Java, and there the increase is so small that it could not have an appreciable effect on the market.

It is reported that the price of manila, which comes into strong competition with the New Zealand product, is so low that those engaged in dressing the fibre are having a hard time. Manila is dressed by very primitive machinery, and the rule is that half the fibre goes to the labourer and half to the landowner. It is stated that a man, his wife, and three children, all working, can earn only £5 17s. per month. The cost of living has increased to such an extent that the labourers can barely make a living, though the requirements of the Natives doing this work are very simple. The Philippine Government is now considering fixing a minimum price, so as to prevent this fibre being sold below the cost of production. Considering all the foregoing points, we have every right to expect good prices for New Zealand fibre in the future.

The cost of planting an area of, say, 100 acres in flax would not be as much as the cost of buying a dairy herd and plant for milking. The return from dairying would be quicker, but the much larger return derivable from flax would more than compensate for its slower arrival

at profit. In order to encourage farmers to grow flax, cheap and reliable plants must be readily obtainable. In nearly all areas planted up to the present the plants have been taken from other flax areas. One acre of a fair flax area grubbed up will provide plants for about 6 acres, which is a very expensive way to get plants. In order to get over the difficulty the seed from the best varieties should be sown in nurseries, and the plants sold to farmers at moderate prices after having been brought well forward. Those farmers who intended planting in a fairly large way could grow their own plants from seed.

It is demonstrable that by growing flax a family could make a good living on a 25-acre farm. Supposing that 20 acres were planted in flax and 5 acres kept for grazing cows, the cows would help to keep down the cost of living, and the farmer could grow his own vegetables. Of the flax area, 5 acres could be cut each year, which would yield 180 tons of flax. Should the farmer cut and deliver his own flax to a mill he should receive on an average £2 per ton for it—that is a total of £360 per annum. Flax-mills could be worked on the co-operative system if the growers found that millers would not pay a fair price for the raw material.

At the present time all flax crops are menaced by "yellow-leaf," but though the disease is doing great damage it is unwise to be pessimistic. Practically all animals and plants are attacked by disease at times, yet with few exceptions the trouble is shaken off sooner or later. I consider that by working up to the selection of flax-plants that have immunity, and by keeping up the vitality of the flax with suitable fertilizers, growers need have little fear that their planted flax will be destroyed.

I estimate that 50,000 acres of good land growing flax will yield per annum 450,000 tons of leaf, giving the following production when milled:—

	£	s.	d.
Hemp, 52,940 tons at £30	1,588,200	0	0
Tow, 8,823 tons at £9	79,407	0	0
Stripper-slips, 4,000 tons at £7	28,000	0	0
	£1,695,607	0	0

On this basis the value of the finished article per acre is £33 16s. Taking the value of the hemp and tow produced, at the highest price during the last few years the return would be over £3,000,000. In these calculations it is estimated that an acre will yield 36 tons every four years, and that 8½ tons of leaf will produce 1 ton of fibre.

Having regard to these returns, it is evident that the cultivation of phormium should be encouraged, and that systematic work should be carried out to find and breed plants that will yield good fibre and resist disease.

A. and P. Societies.—The incorporation of the Rangitaiki Agricultural and Pastoral Society (Bay of Plenty), by Order in Council, is gazetted.

PASTURING LUCERNE.

SUCCESSFUL EXPERIENCE IN NORTH CANTERBURY.

R. McGILLIVRAY, Fields Instructor, Christchurch.

INQUIRIES are frequently received from farmers with regard to the adaptability of lucerne as a pasture plant, sheepowners especially being interested in this phase of lucerne-culture. In parts of Marlborough lucerne has for many years been regarded with great favour for grazing purposes, and the stock-carrying capacity of some farms has been increased thereby to a phenomenal extent. In Canterbury, while there are many well-established stands, it can be said generally that lucerne-culture is as yet only in its early stages; therefore any authentic information as to grazing of the crop is of importance.

The experience of Mr. James Heasley, of Medbury, in North Canterbury, where grazing of lucerne has been practised for five years, will be of great interest to farmers and pastoralists. Much of the land comprising Mr. Heasley's farm is dry and stony, and when the present owner took possession the carrying-capacity was low, being less than one sheep to two acres. Mr. Heasley purchased the farm in the belief and expectation that lucerne could be profitably established thereon, and he has not been disappointed. He acquired the farm in 1914, and immediately took preliminary steps towards laying down 23 acres in lucerne. The following year he laid down another area slightly larger than the first, and consisting of extremely light stony land. He has now altogether about 50 acres under lucerne, and intends to sow another area next spring, hoping to have at an early date from 80 to 100 acres under this crop.

The seed has all been sown with a grain-drill through every coulter, and Mr. Heasley is of opinion that from 7 lb. to 8 lb. per acre is a suitable seeding. One field was by mistake seeded at the rate of only 4 lb. per acre. Such a seeding is manifestly too light; still, the area has given an immense amount of grazing. This area has been down about five years, and it is the owner's intention, when he gets other parts of the farm under lucerne, to plough up the light-seeded area and resow at the rate of 8 lb. per acre. The seed used was of the Marlborough variety, specially purchased at Blenheim. It is of interest to know that the cost of laying down the whole area has been under £1 10s. per acre. No artificial fertilizers have been used, but the first area sown was limed with carbonate of lime at the very light rate of ½ ton per acre. The remainder has not been limed, but it is Mr. Heasley's intention to top-dress with lime and to repeat the application at intervals. Cultivation of the stands has not as yet been attempted by Mr. Heasley. The stony nature of much of the land makes it difficult to stimulate growth in this way.

The lucerne gives an almost unbroken succession of feed throughout the year, including the winter season. Each area is generally given from three to seven days' spell about once a month, as the land tends to get dirty with the heavy stocking. The death-rate among the sheep

grazed has been negligible—not so great as on grass paddocks. In 1914, when the present owner took charge, the farm consisted of 267 acres. Within a recent date he has purchased an adjoining 130 acres, but the

FIG. 1. SHEEP ON LUCERNE AT MR. HEASLEY'S FARM, MEDBURY.

This photo, taken on 16th October, 1919, shows the lucerne stand of 23 acres after being grazed by 258 sheep for nearly six weeks (11 sheep per acre), with only four days' spelling during that time.

FIG. 2. CLOSE VIEW OF SOME OF THE LUCERNE SHOWN IN FIG. 1.

Photo taken after one week's grazing following four days' spell.

[*Photos by E. B Levy.*

greater portion of this block was either in crop or in preparation for same last season. The present carrying-capacity of the farm as compared with that of six years ago must therefore be almost altogether restricted

to the original farm, which, with the exception of the portion in lucerne, is in substantially the same condition as when Mr. Heasley took possession. He has sown down some paddocks with grass mixtures (rye-grass, cocksfoot, and clovers), but these have mostly gone out; so that any increase in stock carried can be almost entirely attributed to lucerne. For some considerable time past a block of 23 acres of lucerne has been continuously grazed by 500 sheep, or at the rate of 22 sheep per acre. This number has now been reduced to 265, or 11½ sheep per acre, and the growth of lucerne is so strong that it is beyond the power of the sheep to keep it down. During the past season 1,700 sheep were actually put away fat off the farm, all of which were purchased as stores, except 400 well-forward wethers, which were only topped off on the lucerne. Mr. Heasley wintered 700 sheep, and it is his intention to increase this number greatly in the future by setting aside about 12 acres of his projected new area of lucerne for hay purposes.

The lightest parts of Mr. Heasley's farm under lucerne are carrying as many or perhaps more stock than land valued at over £100 per acre is doing under ordinary farming methods. Mr. Heasley very correctly looks upon farming as a business proposition, and has kept careful records of his grazing and farming operations, and is in a position to state definitely what numbers of sheep have been purchased, grazed, and sold. His property has been visited by farmers and others, some from long distances, many of whom have been deeply impressed by the good use to which his light lands have been put and the possibilities of similar classes of lands in other districts being made profitable in like manner.

MANAGEMENT OF THE BROOD-SOW AND LITTER.

K. W. GORRINGE, Instructor in Swine Husbandry, Live-stock Division.

A LAMENT is often heard from farmers concerning the bad luck which has attended their efforts in regard to their pigs, especially with the sow and litter. It is a very common occurrence for a sow to farrow ten or twelve pigs and to rear only two or three. Speaking from actual experience, the writer firmly believes that 95 per cent. of these cases occur from want of knowledge and neglect in the care of the sow during the most important time of her life. The breeder must be prepared to give the sow every attention, for in the future operations of rearing and fattening the progeny success depends upon the manner in which she has been cared for; in fact, the sow is the pivot on which depends profit or loss. There is nothing more disheartening than to rear and fatten pigs that have been stunted in growth between the farrowing and weaning stages, a check which can be caused in various ways. The notes which follow will begin at the weaning stage of the young sows that have been selected to become future matrons in the herd, and will deal with them until the period when they have farrowed and weaned their own litters.

THE YOUNG SOWS.

After the young sows have been weaned off the mother they should never be closely confined in a sty, but should be allowed out on open range in pasture and forage crops, these to be supplemented with food such as skim-milk, whey, and any grain ration that the breeder may have. They should not be forced, but allowed to grow and build up their frames in a natural way. If given plenty of good food, with necessary exercise (obtained chiefly from grazing), and with good housing, these young prospective matrons will grow to their fullest, and it is this development which will be of the greatest use to them during their future farrowing-periods. It is advisable that they be allowed to remain under these conditions until they are eight months old. They will then be ready for the service of the boar; under no circumstances should the boar be allowed to run with them up to this time. If the young sows are permitted to mate under this age trouble may result in various ways.

It may be as well here to mention one or two points which will be of service to the inexperienced breeder. The number of teats of the sow is no indication as to the number of pigs likely to be farrowed. Prolificness in the sow is hereditary, and this characteristic should be always preserved by careful selection for breeding purposes. The action of the reproductory organs of the sow at the period of heat determines the size of the litter. The heat period is three days. If a sow accepts service on the first day small litters will usually result. The second and third days are to be preferred, for it has been found from observation that much larger litters follow mating at that time. Assuming that the sow has accepted service on the second or third day, it is advisable that a record of the dates be kept, so that within twenty-one days from the service a watch can be kept on her to ascertain whether she is likely to come on in heat again. If that condition is not manifest it can be practically accepted that she is pregnant. In order to be certain, however, it is advisable to wait another twenty-one days, after which if no signs are present it may be taken for granted that she is all right; in fact, by this time she will be showing visible signs of pregnancy. She should be running out on pasture during this period, and kept there till about one week before farrowing.

THE PREGNANT STAGE AND FARROWING.

There is a point during the pregnant stage which should not be lost sight of—namely, the building-up of the frames of the unborn pigs. Young pigs from different sows, when born, may vary in weight from 1½ lb. to 3 lb. This difference arises largely from the different methods of feeding the pregnant sow up to the time of farrowing. It is not reasonable to expect a sow that has been "earning her own living" out on pasture only—and sometimes very scant at that—to farrow pigs of good uniform weights, but if she has been fed so as to gradually put on condition up to farrowing-time, and during the latter stages had her dietary supplemented with some richer food, she will have every chance to produce a good even litter averaging the higher weight. A pregnant sow should never be very fat, but simply in good strong, healthy, active condition. Her food for the greater part of the period should be rich in protein, as this will greatly assist towards

developing the frames of the unborn pigs—an increase which often amounts to about 2 lb. weekly on an average litter—besides maintaining herself.

The next thing is to see that all arrangements are complete for receiving the farrowing sow. If the breeder has not adopted one of the designs of pig-houses advocated in the September issue of the *Journal*, then the old breeding-pen should be made the best of by being properly cleaned out and thoroughly disinfected, so as to get rid of the parasites and germs that usually infest a sty of this description. A small quantity of short cut straw, or half a bag of old chaff, is all that is necessary for bedding. If a large quantity of straw is placed in the pen the sow in making her nest is bound to pack it well against the sides and thus interfere with the guard-rail. Such a rail should always be placed around the sides to protect the young pigs from being crushed or overlain. Moreover, young pigs have a tendency to bury themselves in the straw, where they are liable to be trodden on and injured.

About a week before farrowing the sow should be brought in without excitement and placed in the pen reserved for her. At this time it is advisable to watch her and note whether she is affected with constipation. This is one of the worst complaints to be contended with in a farrowing sow, and the results are disastrous. If it is seen that the bowels are working freely there is not much to worry about, but to be on the safe side it is advisable to give the sow a little medicine about two days before farrowing. A little castor-oil, Epsom salts, linseed-meal, or a bran mash, in her food, will greatly assist her during this period. She should not be fed heavily during the two days before farrowing, as such rationing has a tendency to make her very uncomfortable at this important time.

After giving the sow every facility for farrowing it is advisable to let her alone. At the same time, and without disturbing her, it is well to be on the watch, as it often occurs that some assistance is required, especially with young sows. It is on such occasions that the breeder gets the benefit of those odd moments he may have spent in rubbing and petting her. The sow is a sagacious animal and never forgets these little attentions. She will stand as much petting as a dog, and always remembers the attendant's voice.

After the sow has finished farrowing it is advisable to remove the afterbirth, as leaving this about is often one of the causes of the sow eating her young. At this stage the young pigs should be examined for sharp canine teeth (which are very often black in colour), and if any are found they should be cut out, thus eliminating another cause for the mother eating her offspring. At the same time it will pay to rub the little pigs over with a rag that has been dipped in kerosene and wrung out. The sow will object to the smell and leave the little pigs unmolested. These points should always be kept in mind and acted upon, for it is no use crying out after the damage has been done and a valuable litter lost.

THE SOW AND YOUNG LITTER.

The sow does not require any solid food for twenty-four hours after farrowing, and all that is needed is to supply her with a drink. She is

apt to be feverish, and some tepid fresh water with a handful of meal stirred in will do her good. The feeding should be in small quantities at first, and be increased daily, so as to bring the animal to a full ration at the end of a week. She should then have as much food as she can properly clean up at a time. At this period the sow requires a much richer food than ordinarily, owing to the severe drain on the system while suckling the young pigs. If plenty of good nourishing food is given her it will be found that whereas the young pigs of a litter of ten or twelve have increased in weight collectively at weaning-time to the extent of about 300 lb. or more the sow will not have lost more than 15 lb. to 20 lb. in flesh. Sudden changes in the food of the sow should be avoided, especially when changing on to green feed, as this is likely to upset her system and the little pigs will get scours and suffer in consequence. They are usually subject to these attacks from birth, and each one means a severe check to their welfare.

In about a week or more after farrowing, according to the weather, the sow should be let out for exercise, and allowed a certain amount of grazing in addition to the other food supplied. This will have a good effect on her, besides allowing her to bask in the sunshine. The little pigs at this stage will follow her and get the necessary exercise, also increased vigour from being out in the sunshine. Should it happen that the weather is bad for some time after the pigs are born, and that they have not had the opportunity or inducement for a scamper, it is advisable that they be chased out of the pen occasionally for the much-needed exercise. It is at this stage that the little pigs often get excessively fat, especially if the sow is a good and heavy milker, owing to their preferring the warm nest to exercising. Often the best piglet in the litter is found dead, and a day or so afterwards the next-best one may follow. If there is still life it is not too late to try and bring the pig round. It should be given a good shaking and at the same time slapped on both sides with the open hand. After watching for results, if it seems to recover slightly, the treatment should be repeated. In many cases the piglets recover right away. As indicated, exercise is all that is required to prevent this trouble.

When a few weeks old the young pigs will be foraging around and helping themselves to a certain amount of additional feed. It is at this time that they should be given a little food by themselves. It is advisable to make a crib in which is placed a shallow trough for the young pigs to feed in; this is done to prevent them from being crushed or injured when feeding with the mother or other pigs. A sow will protect her young in almost every instance except at feeding-time.

At this stage, when the young pigs are continually on the move, it is especially advisable that the feeding-troughs be kept clean, so that no sour or fermented food be eaten by the youngsters, otherwise it is liable to upset them and cause trouble. One cannot be too careful in this respect. The health and condition of the sow should also be carefully observed, for at this period the strain is very severe, and the little pigs being strong and vigorous her ration of ample good nourishing food must be well maintained.

From two to four weeks before weaning castration of the young boars should take place. If this is left till after weaning—unfortunately

a very common occurrence—the youngster will take double the time to recover from the effects of the operation, while if done before weaning in two or three days they are hardly any the worse for it.

WEANING.

It is essential that the young pigs be running out all this time, getting used to the various forms of food, so as to be ready for weaning, which should take place at from eight to ten weeks. If the breeder is desirous of obtaining two litters a year from his sows and of having them come in to dates suitable to himself he should not wean later than at nine weeks. This just gives time to breed with the sows again. It is advisable to commence weaning about ten days before the nine weeks have elapsed. There are various methods adopted in the process, and all have their advantages, but the simplest and most beneficial way for both sow and litter is the following: Wean half the litter first, and at the same time reduce the sow's food; in three days wean half those remaining, cutting off another portion of the sow's food; in another three days remove the remainder; the sow's nourishing food should then be practically nil. By these means the milk-vessels in the sow will have dried up gradually. She should then be fed a quantity of dry corn or oats daily, with plenty of good water to drink.

In about five to eight days after weaning the last lot the sow will be ready for the service of the boar. The breeder should always take advantage of this heat period, as it is recognized to be more certain than other later periods. Then the same practice will have to be observed and followed as described in the foregoing matter.

CONCLUSION.

Summing up, the essentials for success are good housing, with freedom from damp and draughts, cleanliness in all feeding-utensils, sanitation in and around the pens, good water, sunshine, and exercise, also a fair share of intelligence and judgment in feeding. Always remember that it is the little things which count. In the hurry of attending to the many duties comprised in the daily round of the average farmer the small important points of the piggery are apt to be neglected. They should therefore be well impressed on the mind.

Sweet Vernal.—This grass in pastures is generally looked upon as a weed, and the more it spreads the nearer is the need for that pasture to be broken up and relaid. The transition to sweet vernal is general on a great deal of second-class country in New Zealand, and one of our most important pasture problems is to so constitute a pasture on that country that the sweet-vernal transition may be avoided. The grass certainly provides a certain amount of feed in the early spring, it being one of the first grasses to start away. The feed produced, however, is distinctly unpalatable to most classes of stock in the green stage, although when cured as hay this objectionable feature is much lessened. —*E. B. L.*

INDIGENOUS VEGETABLE TANS.

ADDITIONAL ASSAYS.

B. C. ASTON, F.I.C., F.N.Z.Inst., Chemist to the Department.

In the June and September, 1918, numbers of the *Journal* were given a number of assays of the barks of New Zealand native trees for tanning-value. An additional number has since been collected or received, and the results are given below. In all cases in which no acknowledgment is made of the sample having been collected by other observers it must be understood that it was collected by the writer. The results are in accordance with those obtained when working on other samples (previously reported), and indicate that old rough-barked birch, tawhero, or towai trees are appreciably richer in tannin than the smoother-barked younger trees. There is some evidence that altitude may be a factor to be taken into consideration, as there are certain indications that trees of the higher levels yield a higher tannin-content than those of the lower levels.

ASSAYS FOR TANNIN-CONTENT OF NEW ZEALAND TREES.

Lab. No.	Date collected.	Locality, County, and Altitude.	On Air-dried Bark containing 11 per Cent. to 14 per Cent. Water.			Calculated on Bark Dried at 100° C.	Remarks.
			Total Water Extract.	Non-tannins.	Tannin.	Tannin.	
		Fagus (*Nothofagus*) *fusca*, Red Beech or Birch.					
			%	%	%	%	
K/499	7/12/18	Gollan's Valley, Hutt ..	14·7	5·4	9·3	9·9	Old rough-barked trees.
K/598	23/2/19	Gollan's Valley, Hutt ..	16·9	4·9	12·1	13·7	Old rough-barked trees.
K/599	23/2/19	Gollan's Valley, Hutt ..	15·3	5·3	10·0	11·3	Smooth - barked trees.
K/639	30/3/19	Gollan's Valley, Hutt ..	14·7	4·1	10·6	12·3	Rough - barked trees.
K/640	30/3/19	Gollan's Valley, Hutt ..	13·0	5·0	8·0	9·4	Smooth - barked trees.
L/653	24/11/20	Mount Hector, Horowhenua, 2,700–2,900 ft.	19·96	6·6	13·3	17·6	Old trees.
		Fagus (*Nothofagus*) *Solandri*, Black Beech or Birch.					
K/500	7/12/18	Gollan's Valley, Hutt ..	21·0	8·5	12·5	13·4	
K/600	23/2/19	Gollan's Valley, Hutt ..	20·3	8·3	11·9	12·7	Rough - barked trees.
K/601	23/2/19	Gollan's Valley, Hutt ..	18·6	9·5	9·1	10·1	Smooth - barked trees.
K/641	30/3/19	Gollan's Valley, Hutt ..	18·9	6·7	12·2	14·2	Rough - barked trees.
K/642	30/3/19	Gollan's Valley, Hutt ..	14·5	6·8	7·7	9·0	Smooth - barked trees.
K/643	31/3/19	Wallaceville, Hutt, 200 ft. ..	17·2	7·7	9·5	10·9	Smooth - barked trees.
K/644	31/3/19	Wallaceville, Hutt, 200 ft. ..	16·9	6·2	10·6	12·3	Rough - barked trees.

ASSAYS FOR TANNIN-CONTENT OF NEW ZEALAND TREES—*continued.*

Lab. No.	Date collected.	Locality, County, and Altitude.	On Air-dried Bark containing 11 per Cent. to 14 per Cent. Water.			Calculated on Bark Dried at 100° C	Remarks.
			Total Water Extract.	Non-tannins.	Tannin.	Tannin.	
		Fagus (Nothofagus) Menziesii, Clinker Beech or Birch.					
			%	%	%	%	
K/512	14/12/18	Mt. McKerrow, 1,600–2,200 ft...	16·0	6·0	10·0	11·0	Bark 1·5 cm. thick.
L/332	14/8/19	Glenhope, Nelson, 1,300 ft. ..	13·0	7·8	5·2	5·9	
L/652	24/11/19	Mt. Hector, 2,700–2,900 ft. ..	13·0	5·3	7·7	10·4	
		Fagus (Nothofagus) Blairii.					
L/775*	—/1/20	Paradise, Lake Wakatipu, 1,000 ft.	20·1	10·6	9·5	12·1	
		Elaeocarpus dentatus, Hinau.					
K/496	7/12/18	Gollan's Valley, Hutt ..	15·2	7·9	7·3	8·1	
K/638	30/3/19	Gollan's Valley, Hutt ..	12·1	5·9	6·2	7·2	
		Elaeocarpus Hookerianus, Pokaka.					
K/470	17/11/18	Gollan's Valley, Hutt ..	19·3	11·7	7·6	8·3	Large trees.
K/602	23/2/19	Gollan's Valley, Hutt ..	13·1	5·7	7·5	8·5	
		Weinmannia racemosa, Towai or Kamahi.					
K/511	14/12/18	Mt. McKerrow, 1,300 ft. ..	23·0	7·4	15·6	17·0	Mature but thin-barked trees, bark ½ cm. thick.
K/513	14/2/18	Mt. McKerrow, 2,000 ft. ..	27·5	6·0	21·5	23·8	Very old trees, bark 1–1½ cm. thick.
L/654	24/11/19	Mt. Hector, Horowhenua, 1,950–2,400 ft.	22·8	7·3	15·5	21·2	
L/655	24/11/19	Mt. Hector, Horowhenua, about 1,600 ft.	23·0	6·9	16·1	19·5	Larger trees than L/654.
		Weinmannia sylvicola, Tawhero.					
K/563	24/1/19	Thames	15·2	4·9	10·3	11·9	
K/565	25/1/19	Thames	17·3	3·5	13·8	15·7	From old trees.
		Dacrydium cupressinum, Rimu or Red-pine.					
K/501	7/12/18	Gollan's Valley, Hutt ..	13·4	5·7	7·7	8·4	Mature trees.
		Podocarpus spicatus, Matai or Black-pine.					
K/497	7/12/18	Gollan's Valley, Hutt ..	6·0	2·6	3·4	3·9	
		Metrosideros robusta, Northern Rata.					
K/566	24/1/19	Thames	15·7	5·6	10·1	11·6	Old trees.
		Phyllocladus trichomanoides, Toa, Tanekaha, or Celery-pine.					
L/579	22/10/19	Near Lake Rotoma	21·7	13·7	8·0	8·8	Small trees.
L/536†	—/5/19	Mamaku	22·2	7·7	14·6	17·0	Large trees from sawmill.
		Phyllocladus alpinus, Mountain-toatoa.					
L/774*	—/1/20	Paradise, Lake Wakatipu ..	17·9	14·4	3·5	4·4	
L/758	—/12/20	Waimarino, 2,500 ft.	21·4	13·2	8·2	10·2	Large trees.
		Phyllocladus glauca.					
K/564	24/1/19	Thames, 1,500 ft.	16·7	4·3	12·4	14·3	Old trees.
K/567	24/1/19	Thames	23·6	16·7	6·9	6·9	Small branches and cladodes.
		Eugenia maire, Swamp-maire.					
K/498	7/12/18	Gollan's Valley, Hutt ..	19·0	7·6	11·4	12·4	

* Collected by Mr. E. Phillips Turner, Forestry Department.

† Collected by Mr. Rhodes, Manager of Railway Department's sawmill, from large trees cut for timber.

BACTERIOLOGY IN RELATION TO COMMERCIAL MEAT PRODUCTS.*

A. M. WRIGHT, A.I.C.

[From the *New Zealand Journal of Science and Technology.*]

STERILIZATION BY HEAT.

THE preservation of foods by sterilization in hermetically sealed containers was suggested over a hundred years ago. For nearly fifty years the process was chiefly confined to the home, and it was only after the middle of last century that commercial canning passed the experimental stage.

At the outset let it be understood that there is a distinction between pasteurization, in which the temperature is raised sufficiently high to kill vegetative bacterial cells, but not spores, and sterilization, in which the temperature is considerably higher—high enough to ensure the destruction of all bacterial cells, including spores.

Bacteriologically there is a thermal death-point for the vegetative forms, and this is defined as "that temperature which certainly kills a watery suspension of the organisms in question after an exposure of ten minutes." This has been defined further for spores as "that time of exposure to a fixed temperature (moist) of 100° C. necessary to effect the death of all spores present in a suspension." The thermal death-point can be determined with a fair degree of accuracy for each species, and is much higher for spores than for the vegetative forms.

Heat may be applied either in the absence or in the presence of moisture, known respectively as "dry heat" or "moist heat." Dry heat is much less effective than moist heat, the death of the protoplasm taking place more readily in the presence of moisture. In practical sterilization moist heat is therefore used where possible, especially where penetration, as in the case of meats, is required. Steam may be applied under pressure, when a fifteen-minute exposure at 127° C. suffices to destroy all known organisms, the thermal death-point being lower under more prolonged exposure. It has also been demonstrated that for most vegetative forms a temperature of 66° C. will kill with moisture present, while an exposure of an hour and a half at from 120° to 130° C. is necessary to attain the same result with dry heat.

Instead of performing sterilization in one operation, "discontinuous" or "fractional" sterilization may be employed. For this the material is exposed to heat for a few minutes on two or three successive days. Any spores surviving the first heating germinate, and the resulting organisms succumb to the second and third sterilizations. As some spores take days or even weeks to germinate, the procedure is not

* Part of No. 4 of a series of lectures on Applied Bacteriology, delivered at Canterbury College, 3rd May, 1920. The author desires to express his thanks to the New Zealand Refrigerating Company (Limited), and to the Director-General, New Zealand Medical Services (N.Z. Expeditionary Force), for permission to publish the results of these investigations carried out in New Zealand and with the overseas Forces.

always certain in its action, and it is possible for spores to germinate in a material believed to be sterile.

MEAT-CANNING.

The successful canning of food, including meats, depends upon the destruction of all the bacteria present in the material, and the sealing of the can so that no fresh invasion by bacteria or other micro-organisms can occur. This is accomplished by heating the cans and their contents to a temperature that kills not only the bacteria themselves, but also the most resistant spores.

The complete sealing of the can previous to heating is inadvisable, for the steam-pressure inside the can might lead to the formation of leaks that would encourage subsequent infection; hence a small hole is punched in the cover, through which the air and steam escape during the heating process. After the sterilization the hole is closed with a drop of solder, and if the work is effectively performed the contents of the can will remain unchanged for an indefinite period.

The temperature necessary for sterilization varies throughout wide limits according to the nature of the product; for the destruction of bacteria it has been shown that a higher temperature is necessary for the spore form than for the vegetative. Again, it is found that the higher the acidity (within the range of acidity of foods) the lower is the temperature required for sterilizing the food. In general, the spore-forming bacteria do not thrive as well in the more strongly acid foods as in foods of low acidity. This applies especially to fruits and certain vegetables. Meat, probably owing to the difficulty with which it conducts heat to the centre of the can, requires a slightly higher temperature or longer time of sterilization than the majority of other foods.

When it is considered how great the variety is of foods that may be canned, and their contact with air and water, there is no limit to the number and variety of micro-organisms which may be present. Most types of micro-organisms, however, are readily killed in the processing of canned foods, but in some rare cases bacteria appear to be present which withstand the heat of sterilization, and if the cans are thoroughly cooled after the processing, these remain quiescent until the can is stored in a warm place. Such organisms are unusual, but have been known to cause spoilage.

When the closing of the cans is not perfect, bacteria sometimes find their way into the can, either in the water used in the cooling-tank or sprays or subsequently from the air. When a can becomes infected in this way there would appear to be no limit to the variety of bacteria which may be expected. Practically, however, types of organisms will appear which thrive in the constituents characteristic of the food: for example, if sugars are abundant, yeasts and other sugar ferments are usually present; if proteins are prominent and sugars are practically absent, as in meats, then proteolytic organisms will prevail.

Spoilage in canned foods is usually, perhaps always, due to one of two causes—defective sealing of the can, or under-sterilization. Spoilage betrays itself either by the swelling of the can or by an abnormal taste or appearance of the food. Usually it occurs rapidly, and is evident a day or two after the food is packed. When it is remembered that the rate of penetration of heat through the contents of a can depends

largely upon the physical nature of the food, it is evident that slight changes in the character or packing of the food will greatly influence the time of heating necessary for sterilization. Then, again, the bacteria capable of destroying canned goods are not only of different species, but—what is of more importance to the canners—the spores of different species are capable of withstanding different amounts of heating. As a result of this it is possible to operate successfully for a number of seasons at one temperature, and suddenly find trouble when a more resistant species gets into the cans.

The fact that the ends of a can may be bulged does not necessarily mean that the contents are spoiled; if the can is sealed without preliminary heating, or if it is overfilled, the ends may bulge while the contents remain sterile. Notwithstanding this, however, a bulged end on a can may safely be regarded by the consumer as a "warning sign."

In the popular Press warnings are sometimes given against storing food in the open can after part of the contents has been removed, and often the most extravagant statements have been made on this subject. It should be obvious that an open can is as suitable for the storage of food as a tin receptacle of any sort in which most of the milk-supply is held daily. The amount of tin taken up by a food in the one or two days for which it is possible to store food in an open can is very much less than the amount taken up from the closed can between the time of canning and the time it reaches the consumer. Obviously, bacterial spoilage does not occur more readily in an open can than in an open glass dish.

Contrary to the opinions held by certain authorities, solid meat-extract has been demonstrated by bacteriological methods to be a non-putrescible substance, and not to be subject to bacterial spoilage. It has been found to possess properties inhibitory to bacterial growth. These properties are probably associated with its concentration, its salinity, and also with its acidity, for normal meat-juice possesses a marked amount of acidity, due to the presence of organic acids and of inorganic acid salts, which increase in proportion to the concentration of the meat-juice as it is evaporated down in the preparation of the solid extract of meat.

FROZEN MEATS.

Low temperatures have been used by mankind from the earliest times to preserve food from deterioration. While low temperatures suspend bacterial activities, they are not very effective in actually destroying organisms, for it has been demonstrated experimentally that extremely low temperatures injure bacteria only after prolonged exposure.

There is evidence that the flesh of a mammoth incrusted in polar ice, and presumably thousands of years old, has been found to be intact, for, as stated by Nordenskjöld in his book *The Voyage of the Vega*, it appears that the remains were uncovered by the moderation of the weather of northern Siberia, which resulted in land-slides and the disclosure of this mammoth, the flesh furnishing food for wolves and birds of prey. It is a remarkable testimony in favour of preservation by freezing that animal flesh and tissue structures should be preserved at all after the lapse of the thousands of years since the animal died.

It is now recognized that the flesh of healthy animals is free from bacteria, but as soon as death ensues, if no measures are taken to guard

against bacterial infection, the flesh becomes a suitable field of bacterial invasion and growth. As bacteria are almost universally present in the air, it is to be expected that on the surface of meat bacteria will be found, and that if no measures are taken to prevent invasion of the interior bacterial growth will take place there.

It has been found that bacteria and moulds are from a practical standpoint the existing causes of the principal changes which occur in flesh foods, and if these micro-organisms are absent, or their activities suspended, the changes in flesh food will be slow and inconsiderable.

The fact that bacteria are able to withstand exposure to intense cold is of slight importance when placed beside the other fact, well established, that a sufficiently low temperature absolutely prevents growth and multiplication of bacteria, and stops all bacterial action.

Many observations have been recorded and many experiments have been carried out in order to discover whether bacteria are able to penetrate into frozen meats at the temperature of cold storage, and in every case it has been found that, while upon the surface of the frozen meat might be found bacteria, just as in the case of fresh meat, the interior was sterile and free from bacteria. The experiments might be quoted at length, but one only, and that a most important one, will be noted. A tub of water was brought nearly to freezing-point in a freezing-chamber, and to it was added a quantity of a suspension in water of many thousand millions of the micro-organisms of putrefaction, cultured and grown from putrefying meat. Several pieces of meat were now placed in the tub and the whole allowed to freeze. Thus the surfaces of the meat were in intimate contact with a frozen mass containing immense numbers of putrefactive bacteria. The conditions were ideal for bacterial invasion of the meat, if such were possible at the temperatures varying from 15° to 20° C. below the freezing-point of water. At the end of five months sections of the meat showed no indication of the power of bacteria to penetrate into frozen meat.

It is a matter of knowledge that cold-storage meats are more tender than fresh meats, and it has been found that the changes associated with this increased tenderness are due to the gradual and limited work of natural enzymes, such as pepsin and trypsin present in normal flesh, which cause a certain amount of predigestion similar to that occurring when fresh meats are kept for a day or two after slaughter. It has now been shown that several enzymes are present in frozen meats, and they have been isolated and identified in such meats up to six months of cold storage, and it is apparent that the changes found in cold-storage meats are due in a large measure to these substances, and, while enzyme action goes on but slowly at low temperatures, the action is not stopped. This is the reason why refrigerated produce, when thawed, is usually ready for immediate consumption, and does not require keeping.

It has been found that under certain conditions some species of micro-organisms, especially moulds, may develop upon refrigerated produce and, although they do not otherwise change it, may cause discoloration. In some cases these moulds have been isolated and grown artificially. As, however, this subject is one at present under investigation by the author it is not desirable at present to discuss the cause and remedy, but it may be stated that the moulds in question are harmless to animals either when they are fed upon them or when the moulds

and their products are injected subcutaneously and intraperitoneally. There is also evidence that a harmless aerobic coccus is symbiotic with the mould.

OLEOMARGARINE.

In the frozen-meat industry oleomargarine is the caul and kidney fat of sheep and cattle, which is washed and chilled, the hardened fat being then cut up and the disintegrated mass rendered in jacketed pans or melting-kettles at a temperature as low as is consistent with the thorough melting of the fat, so that the membranous tissue is separated and sinks to the bottom of the rendering-kettle, while the melted fat rises to the top of the vessel. After clarifying, further refining, and settling the fat is cooled to the proper temperature for "seeding" or crystallizing out.

In order that no alteration in the composition of the fat due to heat may occur the rendering of the fats for the manufacture of food products is done at a temperature seldom sufficient to sterilize, or even pasteurize, the material; consequently the utmost care requires to be exercised in order to prevent the growth of micro-organisms which might produce bacterial decomposition. Certain undesirable flavours and odours have been definitely traced to the presence of bacteria, which have elaborated enzymes capable of decomposing the fats and the traces of protein substances frequently present in such rendered fats. Pure fat is not readily, if at all, decomposed by bacteria, but if albuminous matter is present the fat may be decomposed by the action of various bacteria and moulds, which derive part of the nutriment for their growth from the albuminous material.

LEMON-CULTURE IN RAROTONGA.

E. A. REID, Rarotonga.

Lemon-growing in Rarotonga is being carried out on systematic lines by Mr. W. G. Taylor, a local planter. The demand for good-quality lemons in New Zealand induced Mr. Taylor to give this branch of citrus-culture a trial, and five years ago he planted 5 acres with the varieties Lisbon and Genoa. These trees have made excellent growth; one section in particular would be hard to beat. The trees in this plot are growing on a small hill of volcanic-clay soil, and they have already proved prolific croppers. The variety Genoa appears to grow to perfection near the sea. Another plot of trees is planted in drained taro land. This soil has proved rather strong for lemons; consequently the growth is rank and the fruiting-qualities have suffered. The trees, however, are healthy, and will stiffen as they mature, and better crops should result.

As regards pruning, once a year the strong leading shoots are headed back, thus inducing the formation of laterals. On the first-mentioned plot tomatoes were grown between the trees for three seasons, the trees

having the benefit of manures applied to the tomatoes. In the last two seasons dressings of bonedust and blood have been applied with beneficial results.

The lemons are gathered as soon as colour is beginning to show. Great care is exercised in this work, up-to-date clippers, picking-bags, and means of conveying the fruit to the storing and curing room being adopted. The curing-room is kept dark but well ventilated, the boxes of lemons being stacked in tiers with ample means of ventilation between the cases. They are carefully looked over at regular intervals, and fruit showing signs of decay removed. In five weeks' time, with favourable weather conditions, the lemons are sufficiently coloured and cured for shipment. They are then carefully polished, graded, wrapped,

SOME OF MR. TAYLOR'S LEMON-TREES.

All the leading shoots would be shortly pruned back.

and packed for export. Grade No. 1 goes 210 and Grade No. 2 180 lemons to a case.

Much criticism has appeared from time to time regarding the suitability of the Island climate for lemon culture and curing, but the experience here related has proved that Island lemons properly grown, cured, and packed are superior to Californian. The colour is particularly attractive, skin thin and tight, juice well retained, and the carrying-qualities excellent. On the open market in New Zealand, in competition with Californian lemons, the price realized by Mr. Taylor was £2 3s. 6d. per case of 180 lemons, compared with Californian at £2 7s. 6d. per box of 300 lemons—this in spite of the fact that the Californian case is more attractive in appearance than the

Island case. This plainly showed that New Zealand people appreciate and are prepared to pay higher prices for choicest fruit.

Many white planters and progressive Natives are following the example of Mr. Taylor's enterprise, and lemon-culture in Rarotonga promises in the near future to become an important industry.

THE NEW ZEALAND SCIENCE CONGRESS.

THE second Science Congress of the New Zealand Institute was held at Palmerston North from 25th to 29th January, under the general presidency of Professor T. H. Easterfield (Cawthron Institute). The formal opening was performed by the Hon. G. J. Anderson, Minister of Internal Affairs.

The Congress was organized in five sections, representing (1) Agriculture, (2) Biology, (3) Chemistry, Physics, and Engineering, (4) Geology, (5) General, with plenary sessions as required. Popular lectures were given on two evenings, and several excursions were also made to points of interest in the Manawatu district.

The Agriculture Section (Sir James Wilson, president) and the Biology Section (Professor C. Chilton, president) occupied a prominent position in the proceedings, as was the case at the initial Congress at Christchurch, two years ago. Contributed papers of direct agricultural interest included the following: "Factors in the Establishment of Lucerne," by A. H. Cockayne; "Some Fodder Crops of England and New Zealand," by J. B. Garnett; "Take-all in Wheat," by R. Waters; "Science and its Relation to Field Instruction to Farmers," by T. H. Patterson; "Some Important Insect Problems of 1920," by David Miller; "The Economic Significance of Powdery Scab in Potatoes," by R. Waters; "The Importance of Soil Survey," by T. Rigg; "Some Aspects of the Flax Yellow-leaf Disease," by A. H. Cockayne and R. Waters; "Some Important Successions in Permanent Grassland in New Zealand," by E. Bruce Levy; "What constitutes a Fertile Soil," by G. de S. Baylis; "The Popular Names of New Zealand Plants," by Johannes C. Andersen; "Inheritance in Self-fertilized Plants, with Exhibits of Wheat," by F. W. Hilgendorf; "The Order Hemiptera in New Zealand, with Special Reference to its Biological and Economic Aspects," by J. G. Myers; "Littoral Plant and Animal Communities," by W. R. B. Oliver; "The Occurrence of Fire-blight in New Zealand," by R. Waters and A. H. Cockayne; "Plant-propagation," by P. Black. Papers on "The Rate of Growth of *Fagus fusca*" and "Natural Afforestation" were also contributed by H. B. Kirk and W. G. Morrison respectively. Arrangements are being made to publish some of the papers in ensuing issues of the *Journal*.

Sir James Wilson reviewed the agricultural position generally in his opening address to the Agricultural Section. A popular lecture of agricultural and horticultural interest was that on "Modern Methods of Scientific Control of Insect Pests," by Dr. R. J. Tillyard, Cawthron

Institute. There was a combination of forces in discussing the flax yellow-leaf problem, as a result of which a committee of scientists and flax-millers was appointed with a view to the establishment of a special biological station to deal with the disease.

The general arrangements for the Congress were made by the local affiliated organization of the New Zealand Institute, the Manawatu Philosophical Society. The latter provided the honorary general secretary of the Congress, Mr. Charles T. Salmon, while Dr. J. Allan Thomson acted as scientific secretary.

A feature of the Congress lay in the strongly practical and economic bearing of the proceedings. Another point worthy of notice was the prominence of young men as regards papers and discussions—a fact which may be held to augur well for future scientific progress in New Zealand.

MAKING A WIRE CABLE ON THE FARM.

A. J. FAULKNER, "Wairakaia," Gisborne.

In these days of expensive manufacture any devices for simple, efficient home-made substitutes are worthy of attention. One of such articles that can be readily made on the farm is a wire rope or cable,

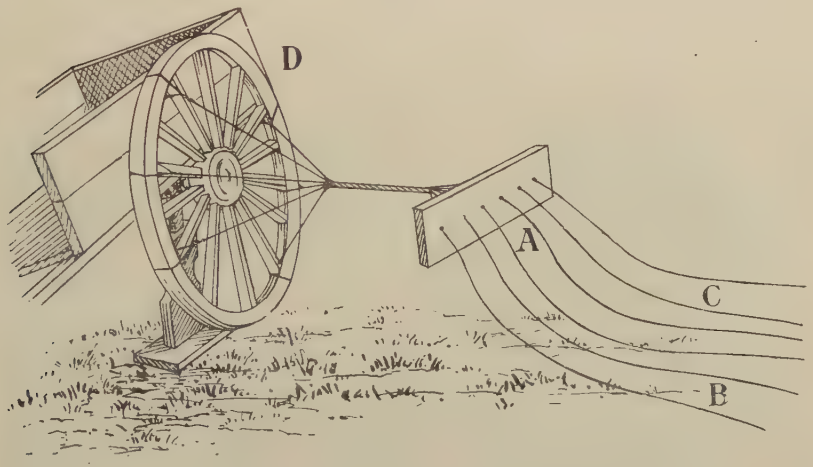

DIAGRAM SHOWING METHOD OF MAKING WIRE CABLE.

For key to letters see text on next page.

such as is required for the construction of flood-gates, suspension bridges, &c.

The accompanying sketch, together with a few notes, will explain the method followed. The apparatus consists of a cart or dray, a

supply of fencing-wire (from 7 to 10 gauge), and a board about 3 ft. long and 1 ft. wide, pierced either in a circle or lengthways with six or eight holes, corresponding to the number of strands of wire used in the cable.

A place with a good level run is chosen and the necessary wires are run out in position. The ends, after having been passed through the holes in the board, are fastened to the spokes and rim of the cart-wheel at regular intervals. The cart is then jacked up on one side, and the operators take up their positions.

To make a six-strand cable four persons are necessary—say, a man (A), and three boys (B, C, and D). A stands between the two middle strands and holds the board, regulating the twisting of the cable; B and C stand between the two right- and left-hand wires respectively, their duty being to keep the wires from tangling, including the middle ones; D turns the cart-wheel.

A then walks backward, holding the board. The quicker he moves the looser is the cable twisted, while the slower he walks the tighter it comes. The speed of the wheel is also regulated under A's instructions by D.

In running out wire for cable-making an extra chain of wire per strand should be allowed for every 6 chains of cable required. Once the wires are run out and fixed to the wheel very little time is taken in twisting the cable, provided that the wires are kept from tangling. In the writer's own experience from fifteen to thirty minutes suffices for twisting a 10-chain cable.

HARVESTING WHEAT AT "THE WILLOWS," NEAR GISBORNE.

WORK FOR THE COMING MONTH.

THE ORCHARD.

It will no doubt be interesting to growers, particularly those concerned in the export of fruit and the many problems connected therewith, to learn that the Department is arranging, through the High Commissioner, for Mr. G. Stratford, Orchard Instructor, Canterbury, who is at present paying a personal visit to the Old Country, to remain in London for the period covering the arrival of this season's New Zealand fruit on the English market, for the purpose of gathering first-hand all information likely to be of value to our future export trade.

Prior to his leaving New Zealand opportunity was taken to fully discuss with Mr. Stratford the many problems requiring elucidation, and the lines on which he should act in the event of his retention for the purpose now arranged. The proposals included a series of experiments in maturity, packing and packages, testing fruit from trees of different ages, &c. The proposals have now been confirmed and arrangements made to put into practice the experiments referred to.

Not only should Mr. Stratford return with valuable information, but we are also assured that while in England he will avail himself of the opportunity of bringing the New Zealand fruit industry before the notice of those interested in such a way as to greatly benefit our future operations.

In the meantime matters relative to the season's export shipments are rapidly developing. Packing in the Nelson district is commencing in the second week of this month, and at time of writing strenuous efforts are being made by the Government and the Overseas Shipping Committee to secure space on an oversea boat due to leave Wellington on 20th instant.

—J. A. Campbell, Assistant Director of the Horticulture Division.

HAWKE'S BAY.

The principal work of the coming month will be harvesting of crops and spraying. Spraying will consist of the application of arsenate of lead, ¾ lb. of powder or 1½ lb. of paste to 50 gallons of water, for codlin-moth, leaf-roller, or pear-slug. A brood of codlin-moth usually appears at this time of the year and lead may be applied with advantage up to within a few days of picking. Keep a lookout for live black-spot and apply lime-sulphur, 1–100, or bordeaux, 3–4–40. Black-leaf 40 has proved the most satisfactory summer control for woolly aphis, to be used when the crop is growing. It may be used in combination with arsenate of lead, but if alone, soap, 3 lb. to each 100 gallons, should be added. Aphis-affected trees from which the fruit has been picked may be sprayed with oil, 1–70. Where summer eggs of red mite are present or mites active regular applications of lime-sulphur, 1–100, will be necessary. Stone-fruit trees with crop should be sprayed with lime-sulphur, 1–120, or trees from which the fruit has been gathered with bordeaux, 3–4–50, for plum-rust, shot-hole, and other fungoid diseases.

Continue cultivation where possible, or run the mower over where the weeds have got ahead. Budding of stone-fruits is now seasonable.

—W. H. Rice, Orchard Instructor, Hastings.

NELSON.

In bearing orchards harvesting and packing the crop will take up most of the very long days that have now to be worked. See that the fruit-store is prepared for recharging. It should be cleaned up and put into repair. A good coat of limewash or a fungus spraying will help here very materially. If the shed is reasonably tight it can be fumigated with burning sulphur.

For a short period after storing commences considerable moisture, &c., is given off by the fruit, and ventilation will need to be given rather generously just then.

It is all the better if fruit goes into the store with a slight coating of spray: one's troubles are not necessarily over when the fruit is picked; many depredating organisms are nearly as much at home here as outside on the trees.

While in the orchard the work is directed by weather and other ever-changing circumstances which make systematizing difficult, in the fruit-store a well-considered system should be adopted. Remember that the first variety to go in will probably be the first required to come out; also it is sometimes necessary to lay one's hand on a certain size of a particular variety. Where this matter is attended to fruit can be marketed in its proper season and losses reduced to a minimum.

Deal with cull fruit promptly; if there is no other use for it the pigs will put it to a good purpose.

Young orchards not in bearing will require attention. Should woolly aphis be troublesome the present is a good time to carry out a spraying campaign with tobacco-extract or red oil.

Some soils go out of condition if the humus and fibre is not continually renewed. Where necessary—especially on the higher ground—a cover-crop of Ruakura oats and hairy vetches mixed may be sown. In bearing orchards this operation will probably have to be deferred for a while.

The spring grafts have made strong growth usually, and many will require to be partially cut back to avoid the danger of being blown out.

Complete the preparation of land for strawberry-planting: it should be clean and in good heart, ready for the plants towards the end of the month.

—W. C. Hyde, Orchard Instructor, Nelson.

MOTUEKA.

Spraying measures in the orchard will consist of regular applications of arsenate of lead, to prevent late attacks of codlin-moth and leaf-roller caterpillar. Lime-sulphur, 1–120, is recommended to keep red mite under control, and to prevent late infection of fungus diseases, particularly black-spot after storage.

By the time these notes appear the export season will have commenced in earnest, therefore a few hints regarding the handling of the crop will not be inappropriate.

Picking: At the first picking select the fruit that has reached the export stage of development only, leaving the balance for a later picking. Every care should be taken by the pickers to avoid bruising the fruit. Cases of fruit should not be allowed to stand about the orchard longer than necessary, but should be taken along to the packing-shed as soon as possible after picking. Should it be necessary to leave any fruit standing for a few hours sufficient shade and cover should be provided to ensure protection.

Grading and packing: Those grading the fruit should also use every care in handling to avoid bruising. Remove all culls and keep the grades to the standards set out. Packing must be done on the numerical pocket system; each packer should indicate in the case packed the number of apples contained therein. It is advisable to have some system whereby the packer of each case may be identified after the case is packed.

Marking: Where stencils are used, these should be branded on neatly and legibly, smudging and incomplete work to be avoided. Labels should be applied with a good reliable paste. Wetting the labels before application has been found a good method of making them stick better. Rubber stamps of the size and particulars conforming to the regulations should be used on labels for filling in the details of the contents of each package. These should be applied neatly and legibly without smudging. *—W. T. Goodwin, Orchard Instructor, Motueka.*

CANTERBURY.

Pests and diseases of pip-fruits: For leaf-roller caterpillar and a probable late infection of codlin-moth spray the trees again with arsenate of lead. Pick and destroy immediately all moth-infected fruits. It seems hardly credible that any fruitgrower would allow moth-infected fruit to lie on the ground until the grubs have left them. It does happen, and it would be well for these careless growers to remember that they are a menace to the industry. For woolly aphis give affected trees a thorough application of Blackleaf 40, 1 in 800, driving the spray well into the colonies. If red mite is present spray again with lime-sulphur 1 in 120, or with Blackleaf, 40, 1 in 800. For powdery mildew cut off all affected twigs and spray thoroughly with sulphur atoms, 1 lb. to 9 gallons, or atomic sulphur, 8 lb. per 100 gallons of water. Lime-sulphur, 1–120, may also be used.

Pests and diseases of stone-fruits: To control the larvæ of longicorn beetle, pick off and burn all dead and dying twigs on plum-trees. Stone-fruit trees affected by any fungus disease should be sprayed with bordeaux, 3-4-50, after the fruit is gathered.

Cover-crops: Orchardists intending to sow cover-crops for ploughing in in the spring are reminded that early in March is a suitable time to sow such crops.

Marketing: Picking and handling is a phase of orchard work which requires a high degree of skill. Fruit damaged in the picking opens up in the market with dark ugly bruises, and has to be disposed of for a few shillings. Mid-season and late varieties intended for storage must be picked as soon as mature, but not ripe. Damaged fruit will not keep in storage. The greatest care must be given to grading and packing. The chief points are size, colour, freedom from disease, and uniformity throughout the case. Read carefully the Dominion fruit-marketing regulations.

Preparations for planting: Intending planters should now order trees as early as possible. When ordering later there is a risk of the varieties required being sold out. Those who intend planting an orchard in the autumn should see to the clearing of the land, ploughing and subsoiling as soon as possible.

Cultivation: Before starting with the picking and marketing of mid-season fruits growers should, where possible, go over the orchard again with the scarifier to stir up the soil. Budding may be done until the early part of March, while the sap is well up.

Superfluous shoots: Remove from the roots and trunks of trees all superfluous shoots, so as to conserve the energy of the trees for maturing buds and wood growth. —*W. K. Dallas, Orchard Instructor, Christchurch.*

OTAGO.

At time of writing very wet weather is being experienced, with a decided drop in temperature. Similar conditions prevailed at this time two years ago, and a heavy infection of black-spot resulted. Growers are cautioned to keep a good watch and prevent a recurrence of the trouble by spraying with lime-sulphur, 1–120, if found necessary, in order to protect the fruit during the late summer and autumn. Mildew will also be controlled by the same means, but where black-spot is not in evidence and the weather is still excessively hot use the atomic sulphur for the control of this disease, at 8 to 10 lb. to 100 gallons.

I have to draw attention to the comparatively large number of apples and pears infected with codlin-grubs in some of the commercial orchards as well as in gardens. Growers are advised in their own interests and in compliance with the Act to pick and effectively destroy infected fruit that has escaped the spray. Several consignments of early pears have been condemned for codlin-moth. Packers should pay particular attention to the calyx end of the pear, as it is here most of the grubs find entrance.

A little red mite is in evidence, and this can be dealt with at the same time as woolly aphis by combining Blackleaf 40 and lime-sulphur or atomic sulphur. Trees affected should be noted, and special attention given when spraying in winter with red oil.

Summer pruning can now be carried out with advantage by cleaning out the surplus growths in the centres of the trees. Care must be taken, however, not to overdo summer pruning by cutting out growths that will be needed for additional framework and fruit-production in the future.

Budding can still be carried out where the sap is flowing freely.

—*J. H. Thorp, Orchard Instructor, Dunedin.*

THE APIARY.

G. V. WESTBROOKE, Apiary Instructor.

PREPARING HONEY FOR THE MARKET.

The question of finding a market for their honey no longer causes any anxiety to beekeepers. In these days of co-operation, when the producers are organized and have their own association to look after the selling end of the business, they can devote more time to seeing that the honey is in good condition and properly packed for the requirements of the market. It is to be regretted,

however, that this matter is not given the attention it deserves. Too little care is taken to see that the pollen-grains, particles of wax, &c., are properly strained out from the honey, and in some cases bees, flies, &c., have been allowed access to the honey, either while in the tank or tins. This results in points being deducted when the honey is graded, and in some instances places the otherwise good honey in a lower grade, with a consequent reduction in price to the supplier. Great care should be taken to prevent any foreign matter getting into the tins or tank, once the honey is strained.

When the honey has sufficiently settled in the tank and begins to show a cloudiness, indicating that it is about to granulate, it should be given a vigorous stirring with a wooden paddle. This will break up the grain and cause the honey to set with a finer grain than would otherwise be the case. Care must be taken, however, to run it off into the tins before it becomes too stiff to run freely. If this is neglected and the honey granulates when in the tank a great amount of work and worry to remove and tin it will be caused. If through any cause it is found that the honey is too far granulated to run from the tap, the best method is to heat up a bucket of honey to about 150° F., empty it into the tank, and stir it well until the bulk is able to run freely. It may be necessary in some cases to add more than one bucket of hot honey, but with care it should not be necessary to have to resort to this measure, which entails a lot of hard work.

Prior to filling the large tins they should be lightly oiled or lacquered, and when dry placed in the cases. These cases, with the tins, must then be weighed and the weights noted. They may then be filled and again weighed in order to arrive at the net weight of the honey in each case. This may be marked lightly in pencil, and the weights stamped on each case before shipping. When such honey is intended for export care must be taken to see that the net weight per case is not more than 120 lb., otherwise it will be rejected.

Another important point that must be kept in mind is that the regulations require that where there is any noticeable difference in the colour or quality of the honey the cases should be marked so as to indicate to the grader that it is not an even line. For instance, the cases could be marked "A" for one extracting and "B" for the other, and so on. There should also be some distinguishing-mark where honey is sent in on different occasions, as the lines bearing the same shareholder's numbers are apt to become mixed when they reach the grading-store. When the honey is sent in an advice-note must be sent to the grader, advising him that so-many cases of honey have been forwarded that day. On the advice-note should be given the producer's number, the weight of the honey, and the distinguishing-marks, to indicate the different lines sent.

Honey should be granulated before forwarding it to the grading-store for export. If it is found desirable to send liquid honey to the depot, the lids of the tins should be secured by two drops of solder, but this must not be done when such honey is for the grading-store.

ROBBING.

From now on great care must be taken to prevent robbing by the bees. As soon as the honey-flow is over it is dangerous to open the hives more than is absolutely necessary, as at such times the bees will take every opportunity to steal the honey from their neighbours. It is also necessary to take precautions to see that no scraps of honey are dropped, and that the bees cannot gain access to any sweet substance. Should they do so it is almost sure to start the whole apiary robbing, and when this happens it is a very difficult matter to stop it. Prevention is always better than cure, and this applies especially to robbing. In order to prevent it as far as possible the entrances of the hives should be reduced somewhat, and any extra opening should be closed down as soon as the flow has ceased. Where it is found that robbing has started on any hive it will be best to close that particular hive down sufficiently to allow only one bee to gain admission at once. If this is not effective it is better to close up the hive and open it after sunset. In slight cases of robbing it is sometimes found that a handful of wet grass thrown against the entrance will check it.

FOUL-BROOD.

If it is found necessary to treat any colony for foul-brood at this time of the year every precaution must be taken to see that the bees do not get any of the infected honey. It is advisable to treat such cases after sunset, clearing everything up before morning.

POULTRY-KEEPING.

F. C. BROWN, Chief Poultry Instructor.

CULLING.

If there is one thing more than another that should be attended to next month it is that of culling out every bird on the plant that is not paying or likely to pay its way during the forthcoming year. While culling of unprofitable stock is one of the chief secrets of successful poultry-keeping, it is nevertheless one of the most difficult matters in any branch of the industry to teach the novice by printed matter. It is a work that can be successfully carried out only by a person possessing a cultivated eye for the laying-type, and capable of making due allowance for the condition of the bird at the particular time the weeding-out process is taking place.

Some breeders, particularly those who are specialists in the business, cull according to the individual record of eggs laid, secured by means of trap-nests, single pens, &c. This is all right in its way, but it is not convenient to the great majority of people keeping poultry to adopt these methods. Therefore if nothing is known of a bird's egg-producing performance she must necessarily be judged according to laying-type and points which denote egg-capacity and constitutional vigour. In this connection a safe principle is to cull out at all times birds showing any weakness in constitution, for no matter how well a bird has laid or how good the type, she must necessarily prove disappointing as a layer once her vigour has become impaired. It stands to reason that for a bird to continue heavy egg-laying (which is an artificially produced condition, and causes a severe tax on the reproductive organs) health and vigour must stand foremost as compared with pedigree of performance, desirable type, or indeed anything else. Particularly does this apply in regard to retaining a bird for breeding purposes. A bird may prove ever so good as an egg-layer, but if in this effort her vigour has been weakened she should be rejected as a breeder, and she will seldom pay to keep for any other purpose.

The time of moulting affords one of the best guides to constitutional vigour and laying-capacity. In this connection the real test of a hen's laying-power is the number of eggs produced from the commencement of the laying-period until the moulting process sets in. For a bird to put up a high egg-yield she must necessarily be a long-season layer, and, obviously, to be a long-season layer she must be a late moulter, for it is rare to see a bird that will renew her feathers and at the same time continue laying. Therefore with birds hatched at the same time, and which have been subjected to similar local conditions, the early moulter is the bird that should be culled and the late moulter retained on the plant. It may be pointed out that the older birds in a mixed flock of first- and second-year layers, where the latter were selected the previous season for the reason that they were late moulters, will usually, owing to their shorter season of production, moult later than the pullets which commenced to lay, say, some time in April. Thus in such cases, where the moulting-period is taken as a guide, due allowance for the age of the birds must be made when culling, otherwise many of the young birds which it would be profitable to keep are apt to be disposed of, and their older but less profitable sisters retained in the flock.

In this connection it should be remembered that generally speaking the second-season layer will take a rest for several months during the dear-egg season before commencing to lay again, whereas in the case of the high type of laying-pullet, bred to commence laying in April, it will often continue the egg-laying period until the following March or April, and sometimes longer. Of course, on all well-managed plants a mark or ring should be placed on every bird as an indication of its age. By this means some poultrymen cull their stock on age alone—that is to say, all birds are retained in the flock until they have terminated their second season of production. This is a weak policy, as in all flocks, and even where the greatest care is taken in the selection and mating of the parent birds, there will be found undesirable progeny not only after the first laying season, but during the early stages of this period as well. In fact, on general appearance alone there are pullets on almost every plant that should be got rid of even before they commence to lay. This is particularly the case with late-hatched stock, the best of which are seldom profitable to keep.

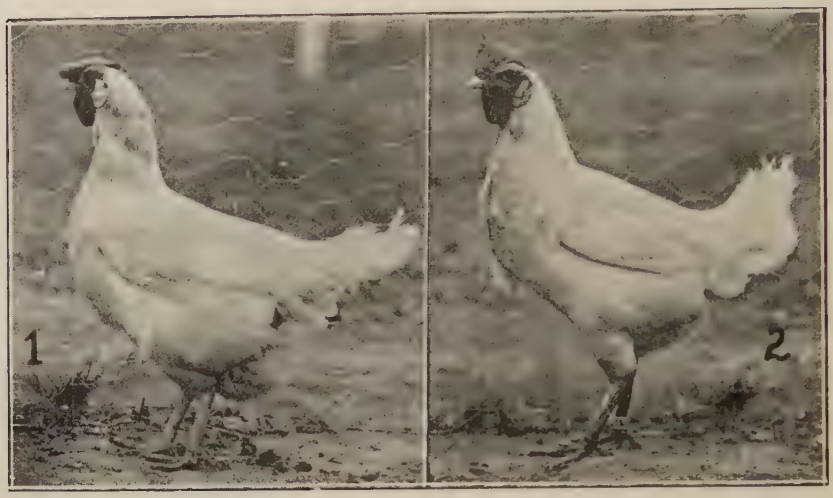

Fig. 1. A Good Breeding Specimen: Showing breed-type, desired size, width of back, well-developed crop and abdomen, depth of body, boldness of eye, bareness of head, tightness of feather, and shabby appearance—indicating high egg-capacity and constitutional vigour. (The bird being in a somewhat squatting posture, her type is not done full justice to in photo).

Fig. 2. A Heavy Producer, after Ten-months' Laying: Bird weak in breed-type and not possessed of sufficient "timber," which condemns it for breeding purposes. In the laying flock it would return a good profit for another season.

Fig. 3. A Freak Type: Bird seventeen months old when photo taken; had never laid an egg, nor likely to do so. Note the masculine characters, particularly in the head, neck, and tail, also the well-kept plumage compared with the shabby appearance of Figs. 1 and 2. Obviously, any such bird should be weeded out.

Fig. 4. Class of Bird not to keep for the Second Year: This specimen moulted early in February and possessed bright yellow legs. Note the dull expression and the heavy feathered eyebrow, indicating a weak constitution.

NOTE.—These photos of White Leghorns were all taken on the same day—28th January, 1921—at one farm.

Of course, the man with the trained eye can tell with a great degree of certainty, by certain signs, the hens that have laid well and that are likely to lay well in the future, and this enables him to weed out the low producers and thereby keep only profitable stock. The following points and the illustrations here presented may be helpful to the novice in distinguishing the class of bird to cull, the bird to retain for egg-laying only, and the bird to select for the breeding-pen at this season of the year. In addition to being a late moulter the high-type layer will present the following signs indicative of constitutional vigour: A clean face, free from wrinkles—in fact, it is not uncommon for the head to become quite bare, a sign seldom or never found in a low egg-producer; a bold prominent eye; close feathering; a bright-red comb (which should be retained more or less throughout the moulting-period); legs of medium thickness (the shank being short and the bone flat), set well apart; well-developed crop; and an alert, vigorous appearance. Further, yellow-legged varieties will now present a bleached or, in fact, a white appearance. It must be noted that this sign only applies towards the end of the bird's productive season, for after it has moulted the legs will regain their yellow appearance, as is the case during the early pullet stage. The heavy layer will also exhibit a more or less shabby appearance, and a lean condition. The birds that should be culled are those that are moulting, those with bright-yellow legs, those above the normal weight of the breed, those with feathered face and dull eye, those with loose feathering, and any which show the slightest weakness in constitution.

SELECTION OF THE BREEDING-HENS.

After the culls have been removed from the flock the remaining birds should be carefully gone through and a selection of hens made for next season's breeding-pen. It is specially important that this work be carried out now, as even with the best layers the points outlined as indicative of laying-power will not stand out prominently again for several months after undergoing the moulting process. In selecting birds for the breeding-pen laying and constitutional points are of prime importance, but desired size and breed-type should be combined. If the breeders are selected now they can be placed by themselves. Then by providing a plain ration they will be discouraged from laying. This will give them an opportunity to recoup and get into a condition to produce early spring eggs, containing strong germs, when the breeding-season comes round. Where every egg is forced out of the late moulter and intended breeder it is safe to assume that trouble will be met in the hatching and rearing of the progeny. Of course, where possible the proposed breeders should be given a free range, as the more natural the conditions the stronger will the vigour of the birds become.

Make no mistake in getting rid of all surplus cockerels that have reached an age of four and a half months, together with any old males that give no promise of future service in the breeding-pen. Remember that these mean a steady drain on the profits made by the productive stock.

MANAGEMENT OF THE GROWING PULLETS.

Where winter eggs are desired the care and management of the growing pullets must claim the first attention of the poultry-keeper at the present time. If not already done, the pullets that are expected to commence laying in April should now be placed into their winter quarters. This is imperative, for any change when the young bird has commenced or is about to commence the laying-period is apt to cause a false moult, and consequently a loss of winter eggs. This undesirable moult will also be encouraged if the ration provided is suddenly changed. It will be seen that the management of pullets from which winter eggs are expected must be uniform in every degree. Therefore the sooner the birds are settled down in their permanent quarters, and become accustomed to a regular diet, the less risk will there be of their moulting with the adult fowls and ceasing to lay when most required.

Of course, if the birds are well grown and nearing the laying-point it will be necessary to include by degrees some forcing diet, such as meat, meat-meal, or milk albumen, which is on the market. The poultryman should not on any account let the increasing price of eggs tempt him to unduly force for eggs with such forcing foods until the birds are well settled down to their business. Especially is this the case where a rich diet is included in the mash mixture. The only safe course is to provide the forcing-material separately, so that each bird can take what it wants and no more. In this way the bird will balance its

own ration better than we can do it for her, as what she likes is usually what she needs to produce her maximum egg-yield. Where a bird is forced to eat in a mash an excess of any forcing-material in order to secure a meal, ovarian troubles, such as protrusion of the oviduct, will result, as well as the production of shell-less and double-yolked eggs.

Do not practise the false economy of giving the laying-pullet a mere living-diet. If winter eggs are to be gathered in large numbers the birds must not only be liberally fed, but in addition the food must be of the best possible quality. Further, do not neglect good sharp grit and crushed oyster-shell. The former will assist the bird to digest its food, while the latter will provide material for shell-making. Charcoal is another thing that should be within reach of the birds at all times to pick at. This is always readily eaten by birds of all ages, and greatly assists towards maintaining them in a healthy vigorous condition.

In addition to liberal feeding and general special care and management, good roomy, well-ventilated houses should be provided. These should be specially prepared to receive the pullets. This applies particularly where adult stock have previously been housed, for there are few flocks of old birds that are free from insect pests. If the pullet is to do her best it is essential that there be no drain on her system through being tortured by parasitic life. The houses should not only be thoroughly cleaned, but in addition well sprayed with a strong disinfectant. Make sure that the floor of the house is maintained in a dry state and covered with litter. A damp floor is not only objectionable from a health viewpoint, but it soon spoils the litter as well.

When the pullets are first put into their winter quarters the houses should be visited for the first few nights, to see that none of the birds are sleeping in odd corners of the house, as once they acquire this habit is is difficult to break them from it. Also make sure that there is no sign of the birds sneezing, &c., indicating that colds are present. Where this symptom is observed the cause should be looked for and removed. Colds are mostly due to a bird sleeping in a draught or in badly ventilated quarters, whereby the house becomes over-warm by night and leaves the bird susceptible to chill immediately she goes out of doors in the morning. Of course, if a bird contracts a really bad cold, it should be isolated at once and treated, as a cold is the forerunner of that dreaded disease roup.

No care and attention is too good for the pullet that is expected to lay in winter. Above all, uniform and regular attention is imperative if the best results are to be obtained, as one day's neglect is apt to throw the bird back for weeks and probably months to follow.

THE GARDEN.

W. H. TAYLOR, Horticulturist.

VEGETABLE-CULTURE.

So far as concerns most places, provision for winter and early-spring requirements is now nearly complete. It would be useless to plant any of the brassica family at the present time, except in some of the warmer districts, and even in such places no time should now be lost. Regarding broccoli, this family requires a long season of growth. If planted very late the plants cannot produce good heads, and may in many instances fail to give satisfactory heads at all. It would be better not to plant them at all, but to grow cauliflowers instead, these coming in much earlier than they can be got in the cooler districts.

Brussels sprouts are a failure if planted very late. They cannot succeed unless thay have a long season of growth. Celery succeeds very well if planted this month, provided it is given a good start by supplying plenty of water. Red spider is likely to attack celery in the warm districts, but it is not likely to be troublesome unless the plants suffer want of water. A small yellowish louse sometimes attacks celery in the warm districts, but it is easily destroyed by spraying with a nicotine solution or XL All fluid.

In most places cabbages, cauliflowers for autumn cutting, broccoli, brussels sprouts, and savoys should be planted during the four weeks commencing with the ast week in December, and in such places the crops should by now be well started

in growth. Such crops should have attention in the way of cultivation. So long as the weather remains dry a dust mulch should be maintained by frequently stirring the surface soil. Deep cultivation should be avoided, as it would have the effect of drying the soil. Two or three inches is a sufficient depth to stir the soil. If the plants seem reluctant to grow, give a dressing of nitrate of soda—½ oz. per square yard. Concentrate the dressing on the area presumed to be occupied by roots. If preferred, the nitrate may be given in liquid form, 1 oz. being sufficient for 3 gallons of water, and giving each plant sufficient to reach the roots. Three gallons should be sufficient for about twenty small plants. It is as well to understand that nitrate of soda does not take the place of other fertilizers. If the soil is deficient in phosphoric acid and potash there will be little or no benefit derived by giving nitrate of soda. Blood-and-bone is a good fertilizer for brassicas.

Onions are nearing maturity. The soil should be kept free of weeds and the surface loose. Beyond this attention no attempt should be made to increase size in the bulbs by watering, or by giving fertilizer in any way, as it would have the effect of preventing proper maturity and make ragged bulbs. Breaking down the tops is rarely required in this country, and only when untimely rains occur. A dry autumn is favourable for the ripening of onions, and when the crop has come along in the proper sequence of growth, and suitable autumn weather occurs, the tops mostly fall without interference and at the proper time. It does happen, however, that some bulbs in a bed may hold their heads up after most have drooped, and these may be bent down. It should be done by pressure with a finger and thumb in such a way as not to break the stem. If it is broken a new growth will start and the bulb be ruined. It may be stated that some growers always hasten ripening by bending down the tops that are already withering. It does no harm in such cases, but probably no good either.

Tomatoes: The most valuable crops are those that are ready early, and to a less extent late crops. The late crop is in most parts dependent on the absence of frost. In some places late crops are specially worked for by planting late, the plants being raised late for the purpose. A wet autumn may bring attacks of potato-blight that will ruin the crop, or an untimely frost may kill the plants. These risks have to be taken; in normal seasons the risk is not great. The early and main crops come from the same plants. The plants are set out at the earliest date experience has shown to be safe and profitable. It is not profitable to plant until the soil is warm enough to promote growth. The plants are usually trained with two stems. All side shoots are pinched out, and when the plants have reached a certain height—usually carrying five branches of fruit on each stem—the top of the plant is pinched or cut off and no more growth allowed. The purpose is to concentrate the energies of the plant on the perfection of the fruit. Each plant could grow a lot more fruit, but doing so would delay progress in the earlier fruit, and the number of bunches mentioned, ripening in succession, gives ripe fruit nearly the whole season. The most important crop would be delayed were more attempted. There is reason to believe that a good deal of the blight that is experienced is caused by the injudicious use of fertilizers and animal or green manure. Being anxious to obtain good crops, growers frequently apply too much acid fertilizer or animal or green manure, both of the latter being acid and productive of soft growth liable to blight. The opinion is expressed that if in such cases a compensating amount of potash were used (which stiffens the texture of a plant), and the soil kept fairly well limed, there would be less blight.

Spinach should now be sown for the winter supply. When the seedlings are well up they should be thinned to 8in. or 10 in. apart. This crop should come into use early in May and stand till October, the large leaves being gathered separately for use. For market purposes it is not convenient to bundle up loose leaves, and the whole plant has to be taken. For this purpose the plants are not thinned much. As a table vegetable the market stuff is very inferior to the large succulent leaves gathered in the home garden.

Turnips for the winter crop should be sown about the middle of March. A white variety should be sown for first use and a yellow-fleshed variety for later. The yellow-fleshed varieties may be regarded as a winter crop. In flavour they are very inferior during hot weather, but distinctly superior to the white varieties when produced under winter conditions.

Pumpkins and other members of the gourd family are now in full crop. Fruits intended for winter use should be taken before the rind gets too hard. If taken when the rind is so hard as to be difficult to penetrate with a thumb-nail the fruits will keep through winter, which is as long as they are generally wanted.

The fruits should be separated from the plants and left lying for a few days where they grew. This will render the skin harder without diminishing the amount of flesh. They can then be stored away in a dry shed or anywhere away from frost.

Herbs, such as thyme, savoury, and marjoram, require cutting over to replenish the growth. The tops so cut may be tied in bundles and hung up to dry for winter use. Hang the bunches stems upward, placing a broad collar of paper over the stems to protect the bunches from dust. Mint dies down in winter. The tops may be gathered and dried in an oven, so that they may be reduced to powder and bottled for winter use. Sage and other herbs may be similarly treated.

Saving seeds of butter-beans and peas: Correspondents have asked for information on this matter. The pods should be perfectly ripe before they are gathered. The beans should be left in the pods for a few weeks, being in the meantime kept in a dry, airy situation. This seems to be necessary to perfect ripening. The beans go bad if taken too soon from the pods. The pod covering appears to affect the beans, at least while there is any substance in it. The beans keep perfectly in the pods all winter, and I prefer this way of keeping a small lot. They may, however, be safely removed when the pods are quite dried. They may then be threshed out, or shelled by hand if only a small lot. Peas are harvested when the main crop is ripe. The pods open spontaneously, so they require watching. They are easily threshed out, when it will be noticed that some peas are lighter in colour than others. This is due to the different stage of ripeness, those of the lighter colour being ripest.

FORTHCOMING AGRICULTURAL SHOWS.

Omaha and Pakiri A. and P. Association: Leigh, 23rd February.
Franklin A. and P. Society: Pukekohe, 25th and 26th February.
Hauraki Plains A. and P. Association: Ngatea, 26th February.
Waikato Central Agricultural Association: Cambridge, 1st and 2nd March.
Egmont A. and P. Association: Hawera, 2nd and 3rd March.
Katikati A. and P. Association: Katikati, 3rd March.
Morrinsville A., P., and H. Society: Morrinsville, 9th March.
Taranaki Metropolitan Agricultural Society: New Plymouth, 9th and 10th March.
Matamata A. and P. Association: Matamata, 15th March.
Hawke's Bay A. and P. Society: Hastings, 15th and 16th March (Autumn Show).
Ashburton A. and P. Association: Ashburton, 17th March.
Mackenzie County A. and P. Society: Fairlie, 28th March.
Methven A. and P. Association: Methven, 7th April.
Mayfield A. and P. Association: Mayfield, 31st March.
Oxford A. and P. Association: Oxford, 7th April.
Temuka and Geraldine A. and P. Association: Temuka, 14th April.

(A. and P. Association secretaries are invited to supply dates and location of their shows.)

Exportation of Hides, Skins, and Leather.—The prohibition of the exportation of hides and calf-skins, leather belting, and leather of all kinds has been revoked by an Order in Council dated 3rd February.

Grading of Butter and Cheese.—Hitherto official grading of dairy-produce has been carried out free of charge. Regulations under the Dairy Industry Act, gazetted on 3rd February, now prescribe fees for the official grading of dairy-produce as follows: 1d. per box of butter of the standard size; 1½d. per crate of cheese. In the case of butter or cheese forwarded for export from a registered factory, creamery, or private dairy the fee is payable by the manufacturer on demand; in other cases the fee is payable by the owner of the produce.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

SLAUGHTERING AND SALE OF MEAT BY FARMERS.

J. C. DEADMAN, Ohakune :—

Will you please let me know what quantity of beef, mutton, and pork a farmer is allowed to sell in one week without a licensed slaughterhouse; also if he can deliver it, and how much is allowed to each customer.

The Live-stock Division :—

Any *bona fide* farmer whose ordinary farming operations include the raising and fattening of stock may slaughter stock on his farm for barter or sale, provided that the number slaughtered in any week does not exceed one head of cattle and five head of other stock, or such larger number as is specially authorized in writing by an Inspector. Except in the case of swine, however, these rights do not apply if the farm is situated in or within three miles of a borough or town district, or if the meat is bartered or sold to a butcher, or anywhere inside a borough or town district or within three miles thereof to any person, or if the farmer fails or neglects to keep a faithful record of all stock so slaughtered and of the persons to whom they are bartered or sold, and to at all times have such record open to inspection by any Inspector. The Act contains no restrictions as to delivery or in regard to the quantity allowed to each customer. The slaughtering for human consumption of diseased cattle is, of course, forbidden. If fuller information on this or any other point is desired a copy of the Slaughtering and Inspection Act may be seen at the office of any Inspector of Stock.

ESTABLISHING LUCERNE ON SHINGLY LAND IN CANTERBURY.

"BRADFORD," Studholme Junction :—

Will you please tell me the best method to adopt in sowing lucerne on shingly land near the sea-beach—whether it should be planted in rows or broadcasted, the best time of the year to sow, the quantity of lime (if any) required, and the variety and quantity of seed required.

The Fields Instruction Branch :—

Provided the land is not waterlogged, or the water-table does not approach within 4 ft. of the surface, lucerne should do well under the conditions mentioned. You are recommended to sow in rows 21 in. apart, placing the seed 1 in. below the surface, on a well-consolidated seed-bed. This spacing allows of intercultivation, thus inducing aeration of the soil, and preventing the growth of weeds. The seed may be sown at any time after the land is warm and danger from late frosts is past—say, mid-October till early March—provided there is moisture in the top 6 in. of soil at time of sowing. Spring sowing is preferable. The land should be limed with ground burnt lime at the rate of not less than 1 ton per acre, put on at least a fortnight before sowing. The liming operation may with advantage be carried out two or three months before the seed is sown. After applying the lime give the surface soil several strokes of the harrows, so as to thoroughly incorporate the lime with the soil. Use Marlborough seed, and sow at the rate of 15 lb. per acre. It is an advantage on all soils to apply inoculated soil to the proposed lucerne area. This soil should be obtained from an established lucerne field and spread over the new area at the rate of 300 lb. per acre. The work must be done on a dull day, morning or evening, as sunlight is fatal to bacterial life.

IMPERFECT WALNUTS.

W. CHRISTIE, Oamaru :-

I have a walnut-tree which has been bearing for many years, but of late the shells have been forming with no fruit inside. Can you advise treatment to cause the fruit to ripen properly ?

The Horticulture Division :—

The failure may be due to imperfect fertilization caused by the loss of the male catkins through wind. Most likely, however, it is due to the soil having become exhausted. The walnut requires a deep and well-drained soil. A thin soil over limestone may produce nuts for a time, but is bound to become exhausted. Unless the soil is of a nature to permit deep rooting the tree is unable to find sufficient moisture at the critical period in early summer. If neither of the reasons outlined apply, the tree may respond to a fertilizer. An authority advises that wood-ashes and soot are beneficial in the proportion of 2 parts of wood-ashes to 1 of soot. An application equal to 4 oz. per square yard applied as a top-dressing in late winter is suggested.

CONTROL OF BRACKEN-FERN.

"FERN," Little Akaloa :—

Can you tell me the best way to eradicate bracken-fern among rocks on a hillside ? It is becoming very thick and choking out the cocksfoot.

The Fields Instruction Branch :—

The fern should be burned in February or early in March. It is often difficult to carry a fire through scattered fern, so it has been found expedient in some districts to stock such country with sheep from good danthonia country. The seed of the danthonia is carried in the wool and in the sheep-droppings, and grows readily. The introduction of danthonia enables a fire to spread through the fern, and the grass puts forth a fresh growth almost immediately after the burn. The sowing of silver-tussock has also been found useful in fern-control, but, of course, the seed would in most cases have to be gathered by hand and should be sown soon after a burn. Heavy stocking with cattle in the spring, following an autumn burn, has also been found good practice. The cattle should be put on before the young fern-fronds uncurl, usually about October. The stock eat a certain proportion and so trample the remainder as to successfully check the fern and enable useful grasses to get a hold. A grass-mixture consisting of cocksfoot, crested dogstail, and white clover broadcasted just prior to stocking would have every chance of successful establishment.

IRON SALTS FOR BUSH SICKNESS.

"BUSH SICKNESS," Oropi :—

I have been closely following the experiments of the Department at Mamaku in connection with bush sickness, and note the successful results of the double-citrate-of-iron-and-ammonium treatment. On inquiring the price of this salt, however, I find that it is such as to make its use almost prohibitive to a man with any number of cows. Could you inform me if sulphate of iron would be likely to have the same effect on cows as the double citrate of iron ? The price of sulphate of iron is as nothing compared with the other, and is quite within the reach of any one if it is at all likely to do any good.

The Live-stock Division :—

Your suggestion that sulphate of iron might be substituted for the double citrate of iron was referred to the Department's Chemist, who gives the opinion that ferrous sulphate is not to be compared in effectiveness with the organic salt of iron in combating bush sickness. It might be possible to obtain a cheaper, cruder salt equal in efficiency to the pure drug for the purpose in hand at the present time, and this matter is being gone into, but as it will necessitate inquiries abroad some time will elapse before this can be ascertained.

WORMS IN PIGS.

M. McFADYEN, Roa :—

Will you kindly inform me as to the best method of eradicating worms from pigs? I keep several pigs, and two of them are badly infested with large white worms from 8 in. to 10 in. long, which keep them in very poor condition.

The Live-stock Division :—

From the description given, the worms infesting the digestive tract of your pigs are probably of the species *Ascaris lumbricoides*. These worms are very frequently found in the intestines of pigs, and unless they are in excessive numbers rarely cause any digestive trouble. The best treatment is to give the pigs no food for twenty-four hours; then give a level teaspoonful of freshly powdered areca-nut in milk for each half-grown pig. The powdered areca-nut should be thoroughly mixed with 1½ pints of milk, which the pigs will take from the bucket. Four hours afterwards the pigs should be given the following purgative: Epsom salts, 2 oz. for each pig, dissolved in about a teacupful of warm water; this should be mixed with two quarts of milk and fed to the pig. This treatment should be repeated twice at an interval of eight days.

COWS EATING SEAWEED AND CHEWING BONES, ETC.

"SEAWEED," Tryphena :—

A neighbour of mine has some cows which as soon as they are let out of the bails after milking go to the beach and eat dry seaweed. They also chew bones, wood, &c. These cows are running on grass, and are also hand-fed with green oats, maize, lucerne, &c. Can you advise as to how this peculiar appetite can be checked?

The Live-stock Division :—

The symptoms seen in your cows are fairly common, and are usually met with in country of a light nature, and more particularly where the pastures have become exhausted as a result of prolonged use without manuring. 1 oz. doses of compound syrup of phosphate of iron (Parrish's food) given twice daily in a bran mash will prove beneficial. This, however, is only treating symptoms. The pastures are lacking in one or more constituents necessary for rendering plant-growth capable of maintaining the animal's body in perfect health. Until these are added by using basic slag or other suitable manures the trouble will be more or less in existence.

TROUBLE AFTER DEHORNING.

W. F. R., Helensville :—

Since dehorning my herd six days ago I have noticed a discharge coming from the stump of one horn on each of six cows. Is this discharge natural, or is it due to some injury? Please advise treatment. I have also two cows with nasal catarrh, and would like advice as to their treatment. Since being dehorned several of the cows have had a slight discharge from the nose, as if they had developed a cold in the head. Is this just a natural result of the operation?

The Live-stock Division :—

The discharge seen after dehorning is caused by the horn and bone getting splintered during the operation. The loose fragments set up inflammation and discharge of matter. This inflammation sometimes extends to the nostrils, giving rise to the discharge from the nose described by you. It is best treated by removing any broken splinters that can be found, keeping the parts clean, and, if necessary, syringing out the parts with a solution of lysol and water, 1 in 80. With reference to the cows with nasal catarrh, Condy's fluid proves beneficial in such cases. A solution can be made by dissolving from 8 to 10 grains of permanganate of potash in a quart of water. A quantity of the solution should be syringed up the cow's nostrils two or three times a week.

TREATING TURNIP-SEED FOR FLY.—TIME FOR SOWING.

C. T. RICKIT, Te Awamutu :—

Could you inform me of any method of treating turnip-seed to prevent the fly from attacking the plants, and of the best time to sow soft and swede turnips. In this district all early-sown turnips have been taken by the fly.

The Fields Instruction Branch :—

The following remedy can be recommended : Mix a cup of turpentine with 1 gallon of water, immerse the seed for one hour and a half, then spread the seed on a tarpaulin for it to dry in the open air ; or spread the seed on a tarpaulin and spray the mixture with a watering-can, and then allow the seed to dry on the tarpaulin in the sun or open air previous to drilling. The best time, as a rule, to sow swede turnips is between Christmas and New Year. For soft turnips, such as Devonshire Greystone and Imperial Green Globe, sow during January and February. If the soft turnips are required for dairy feed sow at the end of October, and they should be ready for feeding during February and March.

[NOTE.—With inquiries of this description correspondents should give briefly particulars of soil, normal rainfall, &c., also state period when the crops are required for stock—not necessarily for publication but for guidance in answering.—EDITOR.]

DESTRUCTION OF BLACKBERRY BY SPRAYING.

J. B., Hastings :—

Will you please tell me the best means of destroying blackberry? Is there any preparation which will kill it and yet be non-poisonous to stock? Ploughing is impossible in this case, as most of the blackberry grows around limestone outcrops.

The Live-stock Division (Noxious Weeds Inspection) :—

So far as we know, there is no preparation, non-poisonous to stock, that will successfully eradicate blackberry. As cultivation is impossible in your case, and probably grubbing of the plant may be also impossible owing to the nature of the land, I would advise removing the stock and spraying heavily with the following mixture : 15 lb. arsenic, 4 lb. caustic soda, 15 lb. washing-soda, 1 lb. resin, 1 lb. saltpetre, 2 lb. bluestone. Boil these ingredients (except the bluestone) in 4 gallons of water for about an hour, or until thoroughly dissolved ; then mix with 100 gallons of cold water. Dissolve the bluestone separately and mix in just before using. If small quantities are being made it is best done in petrol or kerosene tins, which can be destroyed after use. Quantities can be reduced to meet the case if only a small supply of the mixture is required. Should the plants show evidence of sprouting again from the roots a further spraying with the mixture will be necessary. This preparation is highly poisonous, and stock require to be kept off the treated area for about three weeks, or until the mixture has been thoroughly washed in by heavy rains. Some users contend that if 4 gallons of turpentine is added to 100 gallons of the mixture stock will not touch any feed on the treated area, but we cannot vouch for the correctness of this.

HAY OR ENSILAGE.

"FARMER," Tikorangi :—

Could you kindly inform me if 4 acres of grass would provide more feed in the form of ensilage than if made into hay, and, if so, how much more ?

The Fields Instruction Branch :—

Four acres of grass is on the small side to make into ensilage unless one has a silo or pit, as the loss around the sides of the stack would be considerable. A great deal would depend on the quality of the grass ; if the material is good and can be saved in good order it should provide rather more feed value as hay than as ensilage. Three tons of average material will make 2 tons of ensilage or three-quarters of a ton of hay. Analysis shows that approximately 1 ton of good meadow hay is equivalent to 3 tons of ensilage.

CONTROL OF CALIFORNIAN THISTLE.

J. H. D., Matamata :—

Will you kindly let me know the best way of eradicating or keeping down Californian thistle ? It is becoming a great trouble on my farm, and is especially bad the season after I have taken turnips or another summer crop off the land.

The Fields Instruction Branch :—

The method we would recommend to keep the thistle in check is to sow the infested land down to permanent pasture, top-dress the paddocks, and keep the mower going often to cut the thistle in the early stages of its growth. When cut and withered, stock will eat it readily. Small areas can be cleaned by preparing the land and growing lucerne and red clover. Sow from 30 lb. to 35 lb. of lucerne and red-clover seed, in equal quantities, to the acre.

AGRICULTURE IN BACHELOR OF ARTS DEGREE.

At its recent session the Senate of the University of New Zealand reaffirmed its decision to include agricultural science in the optional subjects prescribed for the degree of Bachelor of Arts. The Senate also adopted the following syllabus for agriculture (two papers) :—

(*a.*) *Agricultural Biology.*—The general structure and life-history of the following organisms to illustrate the more important biological phenomena and laws : The bacteria, *Spirogyra*, the yeast-plant, *Mucor*, *Amoeba*, a ciliate infusorian, fly (*Musca*), frog, rabbit, a flowering-plant. General structure of fungi, with especial reference to those species that cause diseases of farm crops ; methods of checking these diseases. General plant physiology—turgor, osmosis, absorption, transpiration. Photosynthesis and assimilation, respiration, translocation of elaborated products and storage of reserve. Nutrition of saprophytes and of parasites. Symbiosis, especially in so far as it is of importance to farm plants. Plant-foods and availability of food material. The general principles that govern the rotation of crops. General features of reproduction, sexual and asexual. The main principles that govern the production of improved races of agricultural plants. Plant-classification in its broader features ; the characters of the following orders of Phanerogams: Cruciferae, Leguminosae, Rosaceae, Umbelliferae, Compositae, Gramineae, Solanaceae, Chenopodiaceae, Polygonaceae, Liliaceae, Coniferae. The botanical and economic character of such members of these orders as are of importance in New Zealand as farm crops, weeds, timber-trees, or hedge-plants. General physiology of animals—nutrition, respiration, excretion of nitrogen, reproduction. General characters of the following groups of animals : Protozoa of the soil, Trematoda, Cestoda, Nematoda, Oligochaeta, Arachnida ; the general zoological characterictics and economic place of the chief insects that are of importance to agriculture.

(*b.*) *Agricultural Chemistry.* — Soils : the origin and classification of soils ; their physical, chemical, and biological characters ; soil-water and soil-atmosphere. The chemistry and physics of the atmosphere, especially with relation to plant and animal life. The preparation and properties of the more important elements and of their chief compounds. The chemical properties of ammonia ; of nitric, hydrochloric, sulphuric, and phosphoric acids, and of their salts, especially as they occur in the soil ; of sodium, potassium, calcium, magnesium, iron, and aluminium, and of important oxides occurring in the soil. The chemical composition and properties of the following manures : Sodium nitrate, ammonium sulphate, calcium superphosphate, basic slag, potassium chloride, potassium sulphate, kainit, chalk, lime ; also of such animal and vegetable refuse manures as Peruvian guano, bone, dried blood. Modern chemical theory treated in an elementary manner.

A candidate in agricultural science will be required to forward to the Registrar before the examination a certificate from a teacher of the subject in an affiliated institution that he has attended a course in practical agricultural science based upon the above syllabus to the satisfaction of the teacher and has passed a practical examination in the subject.

IMPORTATION OF FERTILIZERS: DECEMBER QUARTER, 1920.

FOLLOWING are the importations of fertilizers into New Zealand for the quarter ended 31st December last, the name, quantity, and value of each kind, together with country of departure, being specified :—

Sulphate of Ammonia.—United Kingdom, 100 tons, £4,157; Australia, 235 tons, £6,873: total, 335 tons, £11,030.

Gypsum.—Australia, 1,200 tons, £2,384.

Nitrate of Lime.—Sweden, 5 tons, £119.

Nitrate of Soda.—Australia, 36 tons, £839.

Basic Slag.—United Kingdom, 1,700 tons, £15,553; Belgium, 1,326 tons, £13,248; Luxemburg, 500 tons, £4,722; Netherlands, 50 tons, £467: total, 3,576 tons, £33,990.

Blood-and-bone.—Australia, 138 tons, £2,305.

Bonedust.—Australia, 1,022 tons, £16,209; India, 725 tons, £9,930: total, 1,747 tons, £26,139.

Char Dust (Bone Char).—Australia, 351 tons, £2,763.

Guano.—New Caledonia, 2,370 tons, £6,784.

Rock Phosphate.—Australia, 2,520 tons, £10,108; Makatea Island, 6,628 tons, £16,422; Gilbert and Ellice Islands, 7,900 tons, £19,554: total, 17,048 tons, £46,084.

Superphosphate.—Australia, 13,394 tons, £94,628; Japan, 3,517 tons, £24,881; United States of America, 3 tons, £60: total, 16,914 tons, £119,569.

Other Phosphates.—Egypt, 5,800 tons, £41,470.

Kainit.—Australia, 1 ton, £16; France, 75 tons, £723; Netherlands, 10 tons, £75: total, 86 tons, £814.

Muriate of Potash.—Australia, 10 tons, £292.

Sulphate of Potash.—Germany, 10 tons, £275.

Other Potash.—France, 40 tons, £335.

Other Fertilizers.—Sweden, 2 tons, £151; Australia, 40 tons, £223: total, 42 tons, £374.

NOTE.—With regard to the "declared values" which are given above, the Comptroller of Customs gives the following explanation: "The value for duty is the fair market value in the country whence the goods are imported plus 10 per cent. As the addition of 10 per cent. does not nearly cover the present freight, insurance, and other charges, the statistical value is a long way less than the actual landed value."

GUNPOWDER AS A FERTILIZER.

THE Defence Department has a considerable quantity of gunpowder for sale, which can be used as a fertilizer. It is mainly composed of nitrate of potash, but the proportions vary in the different kinds of powder, the detailed composition in percentages being as follows: Brown powder—nitrate of potash 79, charcoal 18, sulphur 3, total 100; black powder—nitrate of potash 75, charcoal 15, sulphur 10, total 100 per cent. The value of nitrate of potash for tomatoes, potatoes, and plants requiring to make wood is well known; the effect of charcoal is neutral; and the small percentage of sulphur is a distinct advantage in keeping down certain pests. As the trade price of nitrate of potash for manure purposes is 1s. 3d. per pound, and this powder is for sale at 9d. per pound, it would seem to be very good value for those who require potash manure.

Export of Cereals.—By Order in Council gazetted on 3rd February the exportation from New Zealand of wheat, wheatmeal, flour, bran, and pollard is prohibited, save with the consent of the Minister of Customs. The exportation of oats and other cereals, oatmeal, crushed oats, rolled oats, and similar preparations is permitted by the same Order.

ESTIMATED YIELDS OF WHEAT AND OAT CROPS.

THE following estimated average yields per acre of wheat and oats for the season 1920–21 have been compiled by the Government Statistician, from reports furnished by Inspectors of the Department of Agriculture throughout the Dominion, and were issued under date 9th February :—

District.	Wheat. Bushels per Acre.	Oats. Bushels per Acre.
North Island	30·01	37·69
Nelson	24·00	30·01
Marlborough	31·71	44·38
Canterbury	28·63	30·49
Otago	27·33	37·32
Southland	36·56	40·00
Average (estimated) for the Dominion, season 1920–21	28·52	33·86
Average (actual) for the Dominion, season 1919–20 ..	32·66	38·75

In accordance with the above estimates, the total yield of wheat for the Dominion should be approximately 5,975,000 bushels, as against an actual yield of 4,559,934 bushels for the season 1919–20.

The percentage of oat crop threshed in 1919–20 was 34·79 of the total area under that crop. Assuming that a similar proportion is threshed this year, the total yield of grain should be 5,520,000 bushels, as against an actual yield of 6,967,862 bushels for the previous season ; but from the information so far available it would appear unlikely that the proportion of oats threshed this season will be as high as in the season 1919–20.

LAND FOR DISCHARGED SOLDIERS.

DURING the present month the following blocks are being made available for selection by discharged soldiers : Twelve sections in Pukemapou Settlement, Auckland, in areas ranging from 69 acres to 154 acres, suitable for dairying and grazing ; Huia and Karu Settlements, in the vicinity of Ohura and Piopio respectively, containing together an area of 3,042 acres, subdivided into eleven sections, ranging in area from 243 acres to 408 acres, suitable for grazing.

There will be a considerable area thrown open for selection during March, the principal blocks being as follows : Five sections in Taranaki Land District, containing 690 acres ; one section in Marlborough, of 133 acres ; six grazing-areas in Westland, of 1,906 acres ; four sections in Lauriston Settlement, Canterbury, total area 1,000 acres ; one pastoral run in Canterbury, of 3,403 acres ; and three pastoral runs in Otago, containing 8,480 acres.

Heihei Settlement, in Canterbury, containing 58 acres, has been subdivided into seventeen sections of from 3 to 5 acres, and is admirably adapted to poultry-farming.

Teviot Settlement, in Otago Land District, containing an approximate area of 67,200 acres, will probably be available for selection during March, but particulars are not yet available.

Motor Culture.—The French firm of Renault (Billancourt, Seine) has communicated with the Department, stating its desire to enter the new Renault tractor in any motor-culture demonstrations or competitions which may be organized in New Zealand under the auspices of groups of agricultural associations, &c. The firm would be glad to learn of the dates of any such fixtures.

Areas in Orchards, Gardens, Plantations, &c.—Particulars of the area in occupation in New Zealand under this class in 1919-20 (aggregated as 148,760 acres on page 128) are as follows : Commercial orchards—bearing, 15,545 acres ; not bearing, 10,959 acres : orchards for private use only, 6,675 acres ; vineyards, 185 acres ; market gardens, 3,540 ; nurseries and seed-gardens, 456 acres ; private gardens and grounds about residences, 56,837 acres ; plantations, 54,563 acres.

OCCUPATION AND USE OF LAND IN NEW ZEALAND: 1918-19 AND 1919-20.

	1918–19.	1919–20.	Increase.	Decrease.
	Acres.	Acres.	Acres.	Acres.
Grain and pulse crops	750,964	713,446	..	37,518
Grasses and clovers (cut for seed or hay), green and root crops	820,035	935,545	115,510	..
Sown grasses not cut for seed or hay	15,831,604	16,125,265	293,661	..
Fallow lands	68,619	81,760	13,141	..
Gardens, orchards, plantations, &c.	142,115	148,760	6,645	..
Unimproved land	25,729,369	25,468,303	..	261,066
Total area of occupied land	43,342,706	43,473,079	130,373	..

DETAILS OF UNIMPROVED OCCUPIED LAND: 1919–20.

Land District.	Phormium Tenax.	Tussock and other Native Grasses.	Fern, Scrub, and Second Growth.	Standing Virgin Bush.	Barren and Unproductive Land.	Total Unimproved Occupied Land.
	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
North Auckland ..	4,796	218,098	778,577	384,795	106,275	1,492,541
Auckland	8,417	284,054	1,009,790	755,880	67,825	2,125,966
Hawke's Bay ..	433	657,503	450,807	323,155	74,595	1,506,493
Taranaki	54	7,020	63,804	306,679	7,171	384,728
Wellington.. ..	19,357	496,141	292,392	435,780	91,794	1,335,464
Nelson	1,785	299,933	152,980	468,857	45,617	969,172
Marlborough ..	913	1,284,457	248,191	198,702	388,872	2,121,135
Westland	6,478	198,018	75,977	952,301	361,712	1,594,486
Canterbury.. ..	1,468	4,466,004	114,722	230,187	699,663	5,512,044
Otago	1,582	5,628,060	370,119	267,061	278,328	6,545,150
Southland	4,584	1,352,825	165,008	235,546	123,161	1,881,124
Totals	49,867	14,892,113	3,722,367	4,558,943	2,245,013	25,468,303

NOTE.—The total area of New Zealand is 66,292,232 acres.

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IMPROVED SEED-WHEAT.

DEVELOPMENTS IN MAINTENANCE AND DISTRIBUTION.

A. H. COCKAYNE, Biologist to the Department.

THE diminished area of wheat grown in New Zealand and the high price to which milling-wheat has risen are factors which have made it exceedingly desirable that the area sown should yield as great a return as possible. This is equally important from the viewpoint of the farmer and of the general public. The using of better land for wheat-growing and the adoption of the best methods of cultivation are widely recognized plans for securing increased yields, but a third and most efficient method lies in the use of the most suitable varieties of wheats.

At this stage, fortunately, it has been possible to take advantage of the wheat-selection work carried on at the Canterbury Agricultural College, Lincoln, by Dr. F. W. Hilgendorf, both before the war and during its course. A definite and long-continued attempt to improve the wheats commonly in cultivation in the Dominion has resulted in the selection of strains of higher yield than that from the best seed previously obtainable of the varieties concerned. The strains thus selected have in every case been subjected to five years' com-

petitive trial against commercial samples before being distributed to farmers, and during these trials thousands of strains have been rejected and only the very best kept. The result is that when the selected strains reached the farmer they have in each case given improved returns. The improvement aimed at by Lincoln College has been a minimum of 4 bushels per acre throughout the five years' trials. In the farmers' hands this improvement has been generally maintained, and has occasionally risen to 8 and even 11 bushels per acre, so long as the strains were grown on land suited to the particular variety they belong to.

The best known of these strains is College Hunters, or Red Chaff, which was first distributed six years ago. Its popularity, both for yield and quality, is evidenced by the fact that it has now supplanted ordinary Hunters all over Canterbury, and seed of the old kind wanted for experimental purposes cannot be obtained. A leading quality of the College strain seems to be its power of giving a satisfactory yield in almost all seasons, owing to its resistance to adverse conditions.

College Solid Straw Tuscan when grown at the College barely maintained its lead of 4 bushels per acre during its five years of trial, but as soon as it was grown on typical Solid Straw country its lead above the farmers' old seed rose to 5 and 8 bushels per acre. This strain has not the slightest difference in appearance from ordinary Solid Straw, so that good crops of it have not attracted special attention from passers-by. It has therefore not spread with the rapidity shown in the case of Hunters; but in districts in which it has been tried it is generally looked upon as a great improvement on the old Solid Straw.

College Pearl is another strain that was issued three years ago. It is a true Pearl as that term is used in Canterbury, and not a velvet-chaffed wheat. Its yield is good and constant, and the quality of the grain is of the highest and always earns the approval of millers. The land suited for Pearl is not very extensive in area, but in all such districts College Pearl is obtaining a very wide acceptance, founded on the experience of the farmers themselves.

No strain of either of the well-known varieties Velvet and White Straw Tuscan has been distributed under the College name, because none of the strains tried has been found to survive the long tests as to superiority demanded by the experimenter. Fortunately, however, two farmers who have a deep interest in seed-improvement have managed to work up pure seed of these varieties. Mr. H. M. Anderson, of Waikari, started six years ago, and grew many heads of good White Straw Tuscans under similar conditions. After long trials he selected the two best strains, and these he has multiplied and kept pure up to the present time. The seed was at first threshed by flail, and afterwards by a specially purchased machine; impurities have been picked out each year, and the two strains are now available in quantity and are perfectly pure.

At about the same time Mr. J. McCulloch, of Ngapara, finding that the Velvet wheat for which his district is famous had become so mixed that it contained more impurities than Velvet, determined to raise pure Velvet seed of his own. He selected certain good heads, grew them by themselves, and sowed the product, continuing this process year by year until he had two sacks of seed. After this a threshing-mill had to be used, but it was specially cleaned out before dealing with the crop of pure seed. The result is that Mr. McCulloch now has a large area in the progeny of his original Velvet heads, and the seed is so highly appreciated

in his neighbourhood that last year one firm sold over 1,000 bushels for seed to the farmers of that district.

It will be noticed that these last-mentioned strains have not been put through the extensive competitive trials as to yield which the College strains were subjected to, but they are the effect of an effort worthy of the highest praise in private farmers, and have provided a source of pure seed of two varieties in great demand.

Now, all these wheats have cost a great deal of time and money to produce, but the originating farmers have in no case made any profit from them. The seed has been sold at a few pence a bushel above prices for milling-wheat, so that they have become widely distributed and well known. As a result the demand has increased enormously, and is far beyond what can be supplied by the original growers. It was here that there occurred a considerable risk of losing all the valuable work done, for a farmer buying, say, Anderson's pure Tuscan would thresh it in just the ordinary way, and sell it as Anderson's wheat, until in a year or two the strains would become as impure as ever. An attempt to check this was made by Dr. Hilgendorf and the Canterbury Seed-growers' Association, but the work has become too extensive to be coped with by private and voluntary effort.

The Department of Agriculture has now undertaken the maintenance and distribution of these improved seeds. This season farmers who were known to have obtained pure seed were written to and invited to assist in keeping it pure under certain regulations. Where a grower signified his willingness to do so his crop was inspected by an officer of the Department. It was noted if the crop were true to name, pure enough for seed, and free from injurious weeds. Afterwards the best crops were selected among those inspected, and, on the farmer undertaking to do certain work to maintain the purity of some of the seed for his own future use, the Department agreed to purchase the bulk of his crop for sale for seed purposes. At threshing-time an officer of the Department again attended and saw that the threshing-machine was carefully cleaned out before starting on the selected crop, and then branded the sacks of registered seed as it came from the mill. This registered and branded seed-wheat to the amount of about 10,000 bushels is now nearly all in store, and is available for sale to farmers. The growers have been compensated for extra work involved, and added to this are inspection and storage charges, so that the seed will sell at about 2s. 4½d. per bushel above milling-wheat prices.

This higher price will involve an increase of about 3s. 3d. per acre in the cost of wheat-growing, but expenditure on improved seed is always good policy. The cost of ploughing, cultivating, and manuring, and rent, rates, and taxes, are always the same whether a good or a bad crop is obtained, and when the final operation of seeding comes it is wise not to stint a little extra expense if it will mean an improved crop. With wheat at, say, 7s. a bushel it will require an extra yield of only half a bushel per acre for the pure seed to pay for itself, and there is every probability of such seed showing a better increased return than that. Besides this, the certainty of securing seed that an independent man has seen growing, together with the certainty that it is true and pure and clean, is all worth extra expenditure. It is thus expected that the stock of certified seed will be in good demand. Orders will be accepted by any merchant, or by the Department of Agriculture at Christchurch.

LIME AND GROUND LIMESTONE.

METHODS OF PRODUCTION.

W. L. NEWNHAM, A.M.I.C.E., Public Works Department, Wellington.

THE growing recognition of the importance of lime and limestone to the New Zealand farmer has given rise to numerous inquiries relative to the methods employed in the production of lime for agricultural purposes. At present there are two methods in vogue for supplying agricultural lime. The first is by burning limestone in a suitable kiln and producing quicklime, and the second is by grinding the limestone in a pulverizer or other suitable machine to a sufficiently fine state to be assimilated by the soil.

The latter method appears to be coming more into general use, as the initial outlay on plant is very often considerably less than for a lime-burning plant. In this article it is proposed to give a brief description of typical lime-kilns and typical lime-pulverizers. In a short article it is quite impossible to describe in detail all the various processes involved or the various improvements which have been made in recent years, nor is it possible to more than briefly refer to the large modern plants capable of turning out hundreds of tons per week. It is hoped at some future date to publish a further article dealing more fully with the question and the many problems involved.

This article covers lime burning and grinding plants suitable for the individual farmer, or an association of farmers, whose requirements would be moderate and also of an intermittent character. It will be realized that large plants in suitable positions can produce lime and limestone more economically than those of small or moderate size, but the question of transport is usually a big factor in the price of the article as finally delivered on the farm, and in many cases small isolated plants will be found more suitable than large central ones. The introduction of cheap hydro-electric power will doubtless encourage the use of small and moderate-sized plants, especially for ground limestone.

The above remarks apply more particularly to lime-pulverizing plants; it will seldom be found that a small and more or less isolated lime-kiln can be economically used. A kiln of moderate size capable of supplying lime for use over a fairly extensive area will, as a general rule, be found more suitable and economical than a very small one.

For the sake of clearness and for purposes of reference a few brief definitions will be given. Mr. P. G. Morgan writes*: "Limestone may be defined as a rock, generally but not always of a light colour, which on being 'burned' (or, more correctly speaking, calcined) loses considerably in weight and forms the substance known as quicklime. From a chemical point of view limestone may be defined as carbonate of calcium (lime) mixed with more or less impurity. Quicklime may be defined as caustic earth, consisting essentially of calcium oxide, which, when mixed with a small amount of water, evolves considerable heat and forms the

* "The Limestone and Phosphate Resources of New Zealand," Geologica Survey Bulletin No. 22.

substance known as slaked lime. Chemically, quicklime is oxide of calcium mixed with various impurities; slaked lime is hydrated oxide of calcium."

The relative merits of quicklime and ground limestone are outside the scope of this article. They have been fully discussed in various numbers of this *Journal* and elsewhere.

LIME-KILNS.

The history of the evolution of the lime-kiln is very interesting from an engineering point of view, but can only be briefly mentioned, although some of the old types would be quite suitable for use in certain cases at the present time.

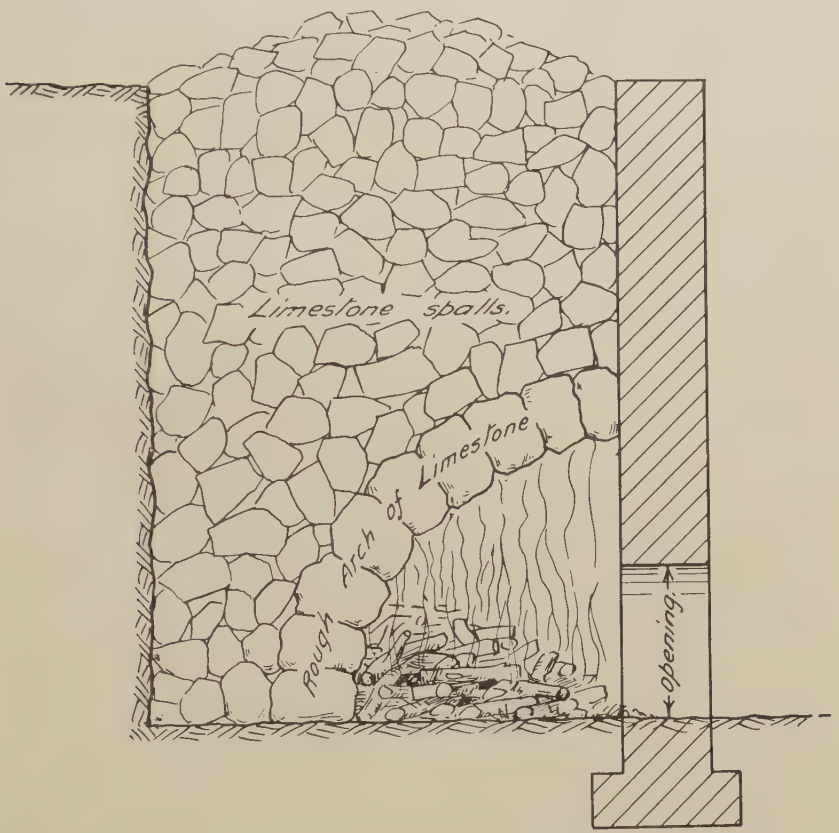


FIG. 1. SIMPLE FORM OF KILN: MASONRY WALLS BUILT UP AGAINST A ROCK-FACE.

The oldest and simplest form of kiln was simply a square chamber cut out of the solid rock, or of masonry walls built up against a rock-face (see Fig. 1). A rough arch of the stone to be burned was built up round a small opening in one side, and the remainder of the stone was packed behind and on top of this arch until the chamber was full.

Fuel was then introduced through the opening in the side and the fire kept up until the limestone in the chamber had been burned to the proper degree.

The flare kiln (Fig. 2) is a further development of the same idea. The chamber is cut out of the solid rock and lined with firebrick. The fuel is burnt at the bottom, a small tunnel at one side being used for the firing of the kiln and the extraction of the lime after burning.

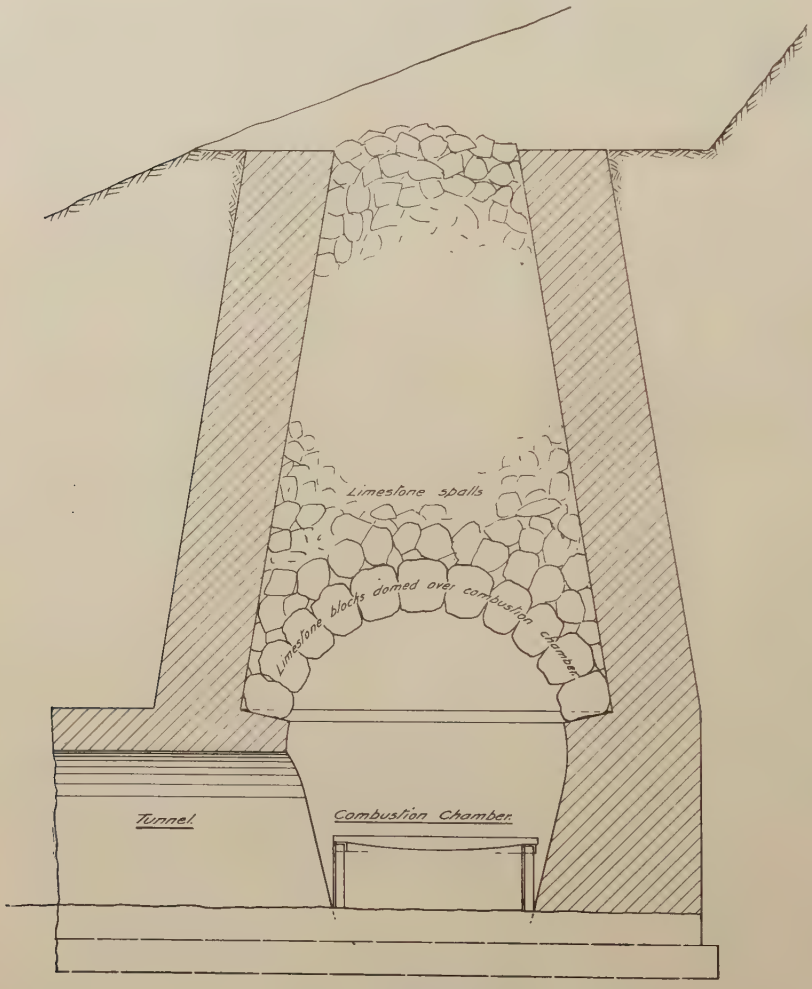


FIG. 2. THE FLARE KILN.

In both these types there is very little contamination of the lime by the fuel, but the cost of burning is high. They are only suitable for a very small output and when a low initial cost is the main consideration. An advantage is that wood can be readily used with these types of kilns.

The simple dome or bottle kiln is somewhat similar in shape to the flare kiln, but the principle of working is different, and the main dimensions are usually greater. The kiln is narrowed in near the bottom, and gratings and draw-holes of suitable size and shape are used instead of the rough arch of raw material. A mixture of limestone and coal is put in at the top of the kiln, the kiln is fired, and when the limestone is properly burnt it is withdrawn through the draw-holes, screened to get rid of the coal-ashes, and bagged for use.

A type of kiln very suitable for use for a moderate output and intermittent burning is illustrated in Fig. 3. It is of simple construction, and could be easily erected without the use of much skilled labour. The size can be adjusted, within limits, to suit any particular locality or output. The kiln and horizontal tunnel for firing and the withdrawal of the burned product are excavated out of the solid in any suitable locality. The tunnel is made any convenient length according to the slope of the ground, and when in good solid rock it need not be lined with concrete. The kiln illustrated is circular in section, about 10 ft. internal diameter, with a height of about 30 ft. from top of kiln to the level of draw-holes. The main wall may be of concrete or ordinary brickwork about 14 in. thick. The space between the outside of the wall and the excavation is usually packed with fine gravel or other suitable material. The inside of the kiln is lined with firebrick. A space of about 2 in. is left between the firebrick lining and the main wall, and this is filled with approved sand. The kiln is narrowed in at the bottom as shown, the section being left large enough to allow for the construction of suitable draw-holes, with chutes and doors for the withdrawal of the limestone after burning. At the level of the top of the kiln tram-lines run to the quarry and the coal-bins or coal-supply. The tram-line extends across the opening of the kiln, and the material is usually tipped directly into the kiln from the trucks. The quarrying of the stone is carried out in the usual way, and if necessary it can be put through an ordinary stone-breaker, but in many instances the limestone is sufficiently soft to enable the use of machinery to be avoided. To charge the kiln alternate layers of coal and limestone are put in at the top of the kiln, until the kiln is full or until charged with the amount required. The results are usually more satisfactory if the kiln is full. The kiln is then fired and allowed to burn from twenty-four to forty-eight hours, according to the nature of the limestone and the amount of fuel used. When the burning is completed the lime is withdrawn through the draw-holes into trucks, and wheeled through the side tunnel to bins or delivery-carts. In the illustration the lime is being tipped from the trucks directly into drays. The draw-holes are fitted with iron chutes, and movable gratings controlled by hand-levers, so that the withdrawal of the lime is easily regulated. The amount of coal required can be determined only by experim nt, but it is usually found that a ton of limestone will require not less than 5 cwt. of coal for its proper calcination.

In many kilns of this type no attempt is made to introduce the limestone and coal in alternate layers, but they are tipped in indiscriminately, a truck of coal following two or three trucks of limestone, and so on. Better results will be obtained if care is exercised in the charging of the kiln.

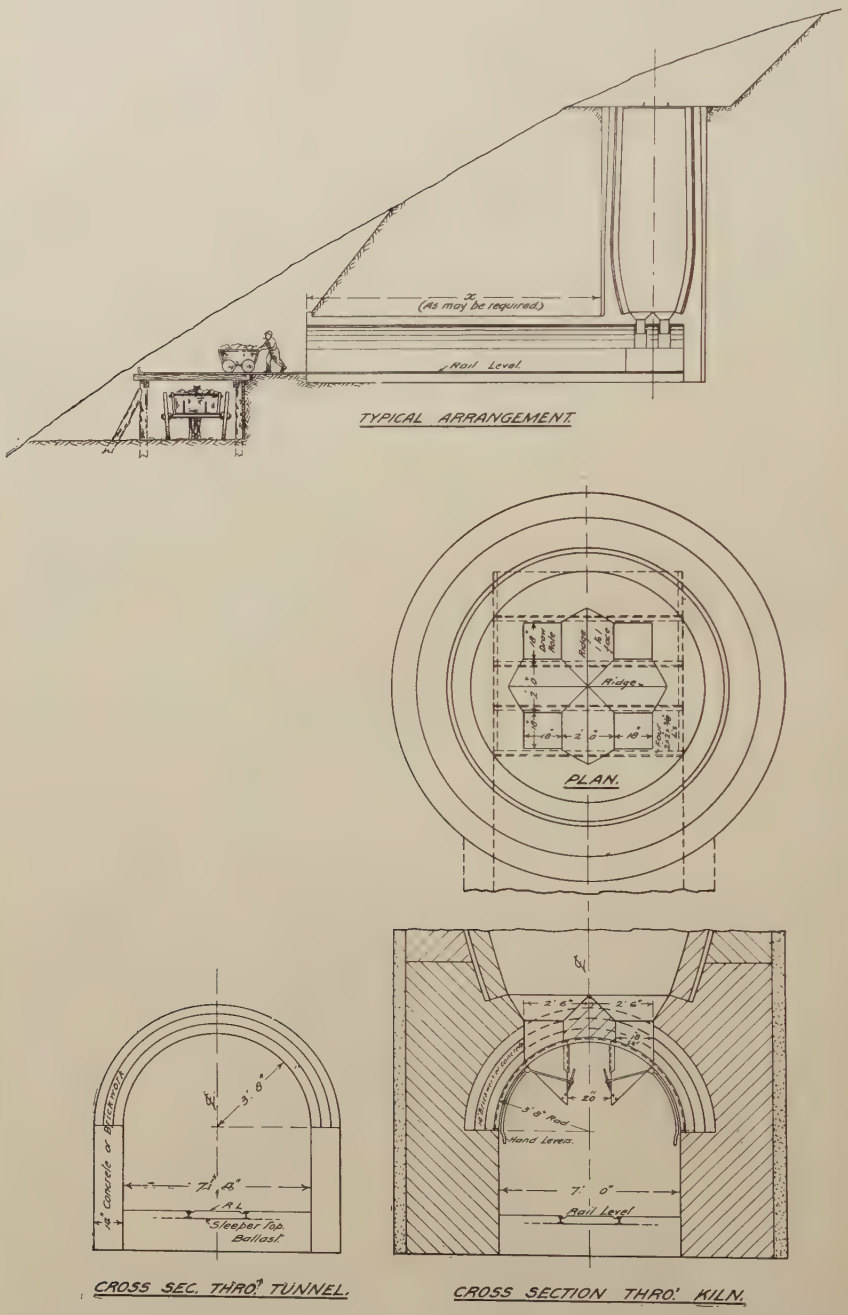
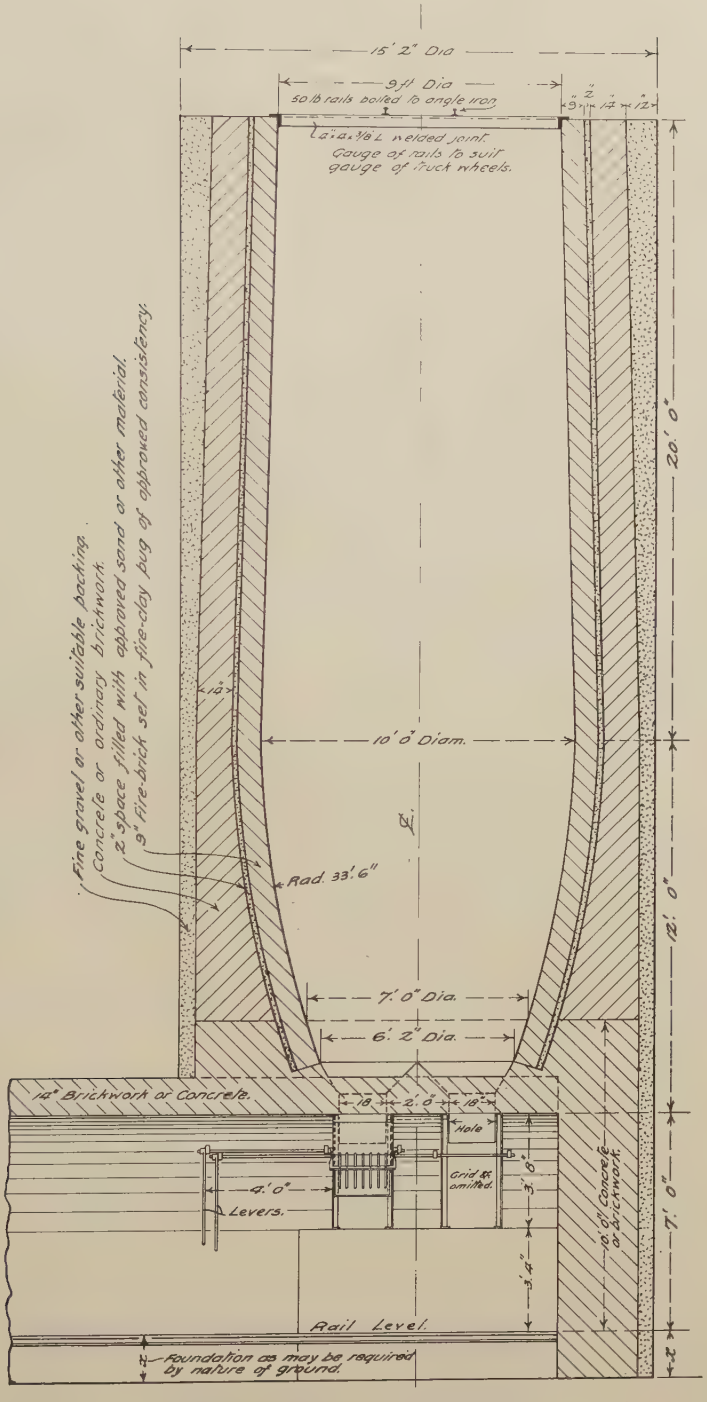


FIG. 3. TYPE OF KILN SUITABLE FOR A MODERATE OUTPUT AND INTERMITTENT BURNING. (SEE PAGE 135.)



LONGITL. SECTION THRO' KILN.

FIG 3. (*Continued.*)

The cost of the kiln illustrated in Fig. 3 would be approximately £1,800, and the output from one charging would be about 40 tons of lime.

Other types of kilns are in everyday use, including continuous kilns in which the limestone is burned out of direct contact with the fuel; gas-kilns, and kilns worked in a similar manner to the ordinary cement-kiln. They are outside the scope of this article, but it is hoped at some future date to describe some of the larger plants.

LIME-PULVERIZERS.

In view of the fact that there are a number of very efficient lime-pulverizers on the market at present it is not intended to describe or illustrate any particular make. Several machines have already been described in the *Journal* (April, 1914, p. 391), and advice as to the merits or suitability of any particular plant will always be given on application. The working principles of a typical lime-pulverizer will be briefly described, and a typical lay-out for a small pulverizing plant will be described and discussed.

The essential features of a machine suitable for lime-crushing by farmholders are: Low first cost, light weight with portability, low power requirement, and simple construction, especially in the wearing parts. It is also usually an advantage to have the crusher and pulverizer as one unit. The machine should also be capable of fine grinding but the range of fineness should be limited.

There are three main classes of pulverizing plants. Firstly, are large plants in which the limestone is first crushed to a suitable size by means of an ordinary stone-crusher, and then ground to a powder in a pulverizer. The two machines are quite independent, but are very often driven by the same engine. Sometimes they are used alternately; a supply of stone is first crushed to the size of ordinary road-metal, the crusher is then stopped, and the power transferred to the pulverizer, which completes the process. In other cases, with a fairly large crusher, crushing and grinding proceed simultaneously, one crusher supplying sufficient small stone to keep two or three pulverizers going, the average output being from 30 to 60 tons per day, according to size of plant.

The second class is suitable for a moderate output, and the crusher and pulverizer are combined as one unit. The limestone goes through the crusher and from there straight into the pulverizer. The average output varies from 10 to 25 tons per day.

The third class includes machines which simply grind small pieces of limestone to a powder. The stone has to be first broken to a suitable size by hand. The average output varies from 10 to 20 tons per day, although it must be remembered that this type of machine when used in conjunction with a stone-crusher, as in the first class, is capable of a much greater output. In some cases also the independent pulverizers are made of large capacity, but are not then suitable for working without a crusher.

The second and third classes are nearly always portable machines, and are especially suitable for use by the individual farmer or a group of farmers.

Most farmers are familiar with the working of the ordinary stone-crusher for crushing stone for road-metal. A description of the working

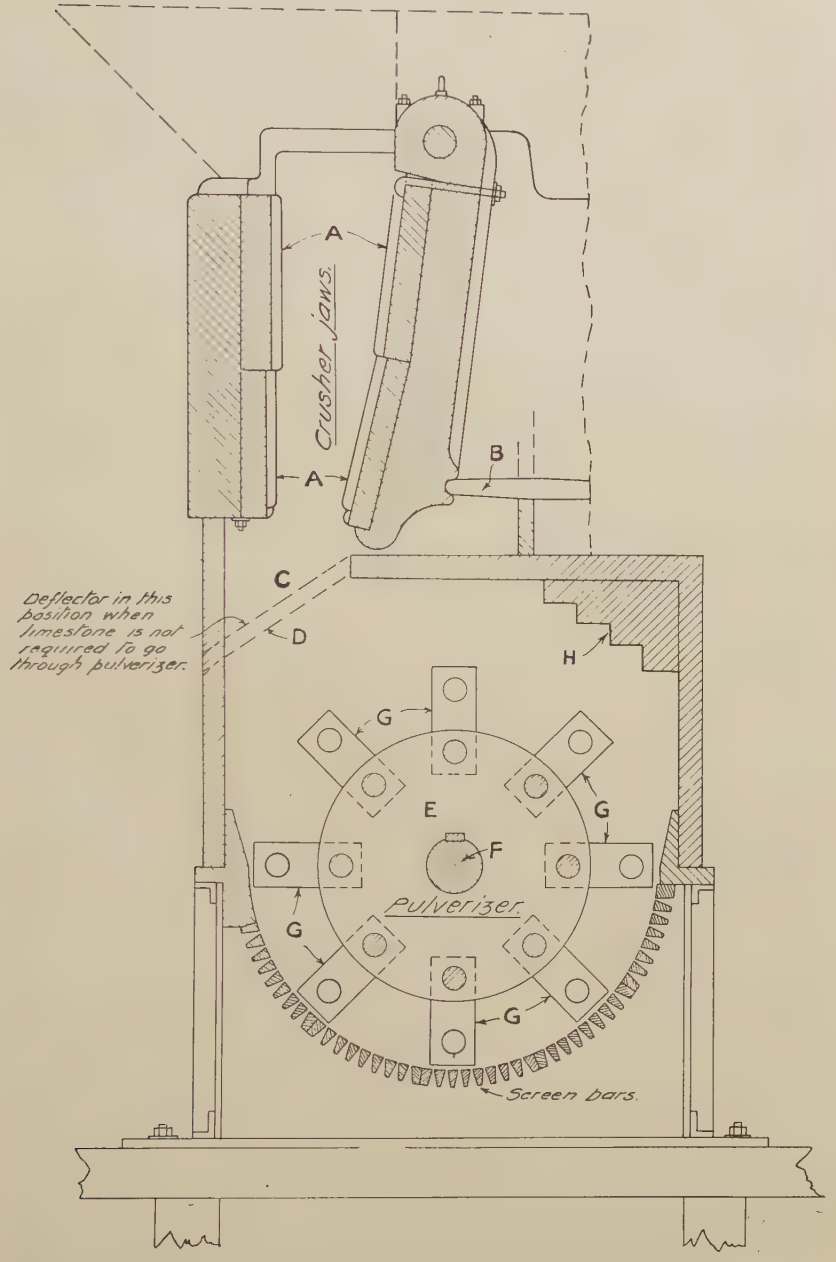


FIG. 4. COMBINED CRUSHER AND PULVERIZER.

Diagrammatic section showing in outline the main working parts. (See page 140.)

of a pulverizer of the second class will therefore be easily followed, and this description will also cover the working principles of machines of the first and third class.

Fig. 4 is a diagrammatic section showing in outline the main working-parts of a combined crusher and pulverizer. The drawing merely illustrates, as simply as possible, the working principles involved, and is not a drawing of a particular machine. The machinery for driving the working-parts is not shown.

The stone is quarried in any size up to pieces about 12 in. by 5 in., and dropped by hand into the jaws (A) of the crusher. These jaws are hung with a larger opening at the top than at the bottom. One jaw is usually fixed, and has sometimes a strong spring at the back of it to take any excessive pressure; the other jaw is hinged at the top. The movable jaw is worked backwards and forwards by means of a toggle-plate (B) actuated by a cam on the driving-shaft. The principle of the working of the toggle-plate enables the jaws to exert great pressure with very little movement. When a piece of rock is dropped into the machine it falls a certain distance and is then caught by the taper of the jaws. As the jaw moves outwards the stone slips down a little, and the closing of the jaw exerts sufficient force to break the stone. As the jaw opens again the pieces fall further down, and the process is repeated until the pieces fall out of the bottom of the jaws into the pulverizer through the opening (C). Between the crusher and the pulverizer there is very often a deflector (D). The deflector allows for the collection of stone for road-metal, concrete, &c., preventing it passing into the pulverizer. When ground limestone is required the deflector is pushed out and the stone falls straight into the pulverizer.

Most pulverizers work on very similar principles. As shown on the diagram, disks (E), usually of cast iron and keyed to a shaft (F), carry hammers (G) which are free to swing on the pins connecting them to the disks. In some machines there are several disks with hammers between; in other machines there are only two disks with a single row of wide hammers in between them. Experience has proved both types to be efficient. Very often, as is shown in the diagram, the hammers are double-ended, and provided with two holes so that they can be reversed when worn at one end. The wear-and-tear on these hammers is very great, and they should be of very tough material. Manganese steel is very suitable.

When working, the disks revolve at high speed (usually from 1,000 to 2,000 revolutions per minute), the hammers take up a radial position, and strike the material as it falls from the crusher against a breaking-block (H). The disintegrated material falls down against the screen-bars, is finally ground to a powder by the revolving hammers, and forced out through the openings between the screen-bars. Sometimes a set of crushing-rollers is introduced between the crushing-jaws and the pulverizer. This increases the capacity of the machine to some extent, but is not absolutely necessary.

Machines of the first and third class work on the same principle, with the necessary modifications. In most cases combined crushers and pulverizers are recommended for use by farmers.

In all classes of pulverizers the degree of fineness of the product is governed partly by the size of the openings between the screen-bars

(which can be adjusted), and partly by the speed at which the machine is driven—the higher the speed the finer the product. As will be seen later, the amount of moisture in the stone also affects the fineness of the product. The product to be aimed at is one in which there is very little stone above $\frac{1}{6}$ in. diameter. If the greater part is reduced to that size, then sufficient fine and very fine stuff will be produced to render the

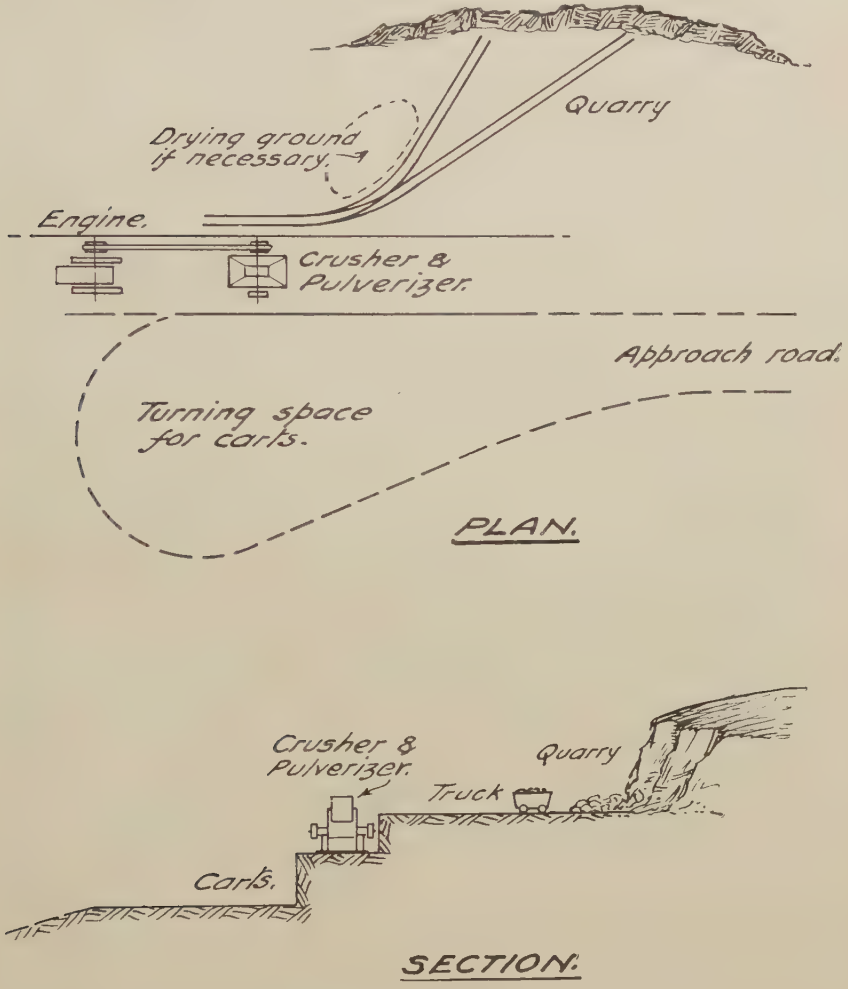


FIG. 5. TYPICAL LAY-OUT FOR A CRUSHING AND PULVERIZING PLANT OF MODERATE SIZE. (SEE PAGE 142.)

result satisfactory. To have too much very fine material is rather detrimental, as the whole of this very fine material will probably become absorbed into the soil during the first year, leaving less for succeeding years; also, considerable loss of the finest particles is likely to occur during transit and distribution.

The output of a pulverizing-machine is largely governed, as might be expected, not only by the hardness of the stone, but by its toughness, and also by its dryness. In some instances it is found, especially with limestone which is not crystallized, that the material contains too much moisture to pass easily through the pulverizer or be reduced to the required degree of fineness, and it therefore becomes necessary to submit it to a preliminary drying process. In large plants this is sometimes effected by means of a rotary kiln similar to those now used in the burning of cement clinker. In other cases the stone is passed through an ordinary lime-burning kiln, but with only sufficient fuel to dry it and not to calcine it. With a small plant, of course, it would only be possible to dry the stone by exposing it to the wind and sunshine for the required length of time.

Preliminary trials must therefore be made to ascertain whether the stone will pulverize without drying. In the summer-time it is probable that little difficulty will be experienced, as during the warm summer weather exposure to the sun, even with a moist stone, is usually sufficient. If the expense of drying a moist limestone, especially in the winter-time and wet weather, is very great, continuous pulverizing will not be possible, and the operation will have to be carried out only in suitable weather, or a kiln built, whichever is likely to prove the more economical. Attempts have been made to produce a machine capable of pulverizing moist limestone without preliminary drying, but so far they have not met with much success.

The power required for various machines is, of course, governed by the size and capacity of the pulverizer. For a machine with an output of about 1 ton per hour, 10 brake horse-power will usually be required. It is necessary to increase the power somewhat in proportion to the output; 2 tons per hour would require about 15 horse-power.

Fig. 5 shows a typical lay-out for a plant of moderate size. The section gives some idea of suitable relative levels for the different parts of the plant. The stone is brought from the quarry-face in small trucks, and after crushing and pulverizing is carted away in drays, wagons, or motor-lorries. The engine is usually steam- or oil-driven. Where electricity is available a motor could replace the engine, or be directly coupled to the crusher and pulverizer.

The details of the plant can be varied in a great many ways. Bins can be provided to allow for a certain amount of storage, but extensive storage entails considerable capital expenditure and is not recommended. A bagging-elevator can be added to the pulverizer, and the crushed limestone bagged for transport or storage. The main idea in all plants is to reduce the handling of the material, and with it the labour, to a minimum.

A plant on lines similar to Fig. 5, and with an output of from 15 to 20 tons per day, would probably cost about £800. The cost of pulverizing the limestone, including getting stone, fuel for engine, oil, wages, interest on capital, and depreciation, would probably range from 12s. to £1 per ton of crushed limestone.

In a locality where there are small deposits situated at some distance apart from each other a small portable plant will probably be found most suitable. A small tractor could easily haul the portable pulverizer to any location, and drive it when in position.

FIREBLIGHT.

BACTERIOLOGICAL HISTORY IN NEW ZEALAND.

R. WATERS, Biological Laboratory, Wellington.

[Paper read at the New Zealand Science Congress, January, 1921.]

As soon as the presence of fireblight was suspected in the Auckland Province (towards the end of 1919) the demand for a specific identification came with great urgency. The work was promptly taken up at the Biological Laboratory of the Department of Agriculture, and this paper gives a brief account of the investigation and its results.

PEAR ISOLATIONS INOCULATED INTO PEAR FRUIT.

Specimens of infected pear-shoots were obtained from Te Papa, near Auckland, and from them were isolated such bacteria as were present. The result of plating out from infected material showed a great predominance of one particular colony type closely resembling that of *Bacillus amylovorus*. This organism was therefore taken into pure culture for inoculation purposes. The first inoculations were made into green pears, as follows: (1) One pear inoculated with the New Zealand organism just isolated; (2) one pear inoculated with sterile water—the control. In three days the New Zealand organism commenced to infect, and in five days bacterial ooze typical of fireblight was issuing at many points from the skin about the point of inoculation.

The New Zealand organism was recovered from the abundant ooze, which when plated out showed a pure growth of an organism with the same colony characters on beef-peptone-agar plates; the same biologic reactions in broth, skim-milk, litmus milk, and on agar slopes, Loeffler's serum, beef-peptone-gelatine slabs; motility; and the same size and staining reactions as the original organism used as the inoculum. This indicated that the organism recovered after its pathogenicity had been established was the same as that inoculated into this pear. For the sake of convenience the recovered bacillus was called the "New Zealand fireblight bacillus."

COMPARISON OF THE NEW ZEALAND WITH THE AMERICAN BACILLUS.

A culture of *Bacillus amylovorus* having been received from Dr. L. R. Jones, of Wisconsin University, U.S.A., these two organisms were then compared, and were found closely to coincide in morphology, motility, staining reactions, and biologic characters. One character, however, was found peculiar to the New Zealand bacillus on agar plates—namely, the wavy radiations in the colonies, a feature which has subsequently been of much service in rapid diagnosis. However, the American organism, attenuated through adverse conditions in transit or otherwise, was shown to have lost its pathogenicity, no instances of infection having occurred in any of the experiments with it.

HAWTHORN ISOLATIONS INOCULATED INTO PEAR FLOWERS AND SHOOTS.

By this time lesions and bacterial ooze had been reported by the Horticulture Division of the Department amongst the hawthorn hedges of the Hamilton vicinity, as a result of which a cablegram was sent to Washington inquiring whether *Bacillus amylovorus* could carry over the winter in this shrub. The reply received was: "Hawthorn may possibly carry hold-over bacillus." This necessitated experiments to ascertain whether the organism producing cankers and ooze in our hawthorns was capable of infecting fruit-trees.

Gross inoculation of hawthorn ooze direct into pear-flowers in the field was found to produce characteristic fireblight blossom-infection. Simultaneously nine different organisms were isolated from hawthorn ooze from Hamilton, one of which coincided in its agar-plate colony characters, morphology, motility, and staining-reaction with the New Zealand fireblight bacillus derived from pear. Repeated isolations from hawthorn confirmed the presence of this organism, which regularly exhibits more or less distinctly wavy radiations as an internal colony character. Inoculations of pure cultures of this organism into pear-shoots produced the characteristic symptoms of fireblight, including bacterial ooze. These experiments establish the fact that the pear may be infected with hawthorn ooze, a consideration that is fundamental to the formulation of control measures.

Hawthorn ooze was decidedly rare in the Hamilton district this past year prior to the flowering-period of pip-fruits, but became very common whilst the blossoming-period was in progress.

PEAR ISOLATIONS INOCULATED INTO PEAR AND HAWTHORN FLOWERS.

When the occurrence of fireblight symptoms at Opotiki called for a specific identification for this locality, opportunity was taken of testing the infectivity of pear-derived cultures upon hawthorn — the reverse of the preceding experiment. From Opotiki pear fruit-spurs four organisms were isolated, each of which was inoculated into both pear and hawthorn flowers, which were then incubated at 25° C. In three days two of these organisms produced distinct fireblight symptoms, including ooze from the pedicels of both pear and hawthorn flowers, whilst the other two organisms and the control gave negative results. These two positive cultures were derived from typical wavy radiating colonies, which were indistinguishable from those of the original New Zealand fireblight bacillus from pear.

DIAGNOSIS.

The value of these wavy radiations in rapid diagnostic work have become more and more apparent, for in no case have such organisms failed to infect. When, moreover, specimens of the disease had to be dealt with in very large numbers it became a matter of necessity to adopt some abbreviated method of identification. The following method is briefly the one that has frequently been applied in ordinary circumstances for the diagnosis of fireblight, further tests being applied if the symptoms were atypical:—

Twig-infection.

(1.) Macroscopic: (*a*) Browned or blackened petals; (*b*) moist darkened tissues of calyx-cups; (*c*) moist darkened bark; (*d*) browned

or blackened leaves; (*e*) exudate from calyx-cups and pedicels, and blistering and exudate on twigs; (*f*) incurving apex of shoots.

(2.) Microscopic: (*a*) Great abundance of bacteria in typically disorganized tissues; (*b*) absence of fungal hyphæ.

(3.) Cultural: (*a*) Colonies visible without magnification in thirty-six hours at 25° C.; (*b*) predominance of round, smooth, slightly raised, finely granular, whitish (reflected light viewed from top) colonies, which when widely separated on beef-peptone-agar plates show wavy internal radiations (like wavy hair) from the centre to near the margin, which is finely granular. Size 3 mm. to 4 mm. in ninety-six hours at 25° C.

Note: Probably 10 per cent. of the specimens sent in as suspected fireblight were affected only by borer. Tissues incidentally killed above the borer-holes dry out rapidly, bacteria are not abundant in them as in fireblighted tissues, and the hyphæ of various saprophytic fungi subsequently are met with in section.

Cankers.

Fireblight cankers are distinguished by the moister condition of affected tissues, especially when the organisms are active, and by the great abundance of bacteria then present as compared with the numbers accompanying fungoid cankers. They are further distinguished by the absence of fungal hyphæ, which occur in abundance in fungus cankers.

HOSTS.

A number of plants other than the recorded hosts of fireblight have been received from time to time under suspicion of being infected by this disease. These comprise the following: Plane-tree, affected by *Gloeosporium nervisequum* Sacc. (common); nectarine, affected by *Sclerotinia cinerea* Wor. (common); *Cupressus macrocarpa*, affected by *Fusarium* sp.; mulberry, affected by *Fusarium urticearum* Sacc. (very common); camellia, affected by *Pestalozzia Guepini* Desm. (rare); titoki mangrove, plum, totara, rose, poplar, and tecoma, all affected by borer; blackberry, affected by *Leptosphaeria coniothyrium* Sacc. and *Gymnoconia Peckiana* (Howe) Atk.

Finally, a specimen of medlar was received on 10th December, 1920. This specimen bore strong macroscopic resemblance to fireblight, and in section showed the presence of an enormous number of bacteria and on fungus hyphæ. Two organisms, which were both plentiful in the tissues, were isolated, one of which developed the colony characters of the New Zealand fireblight bacillus, including the wavy radiations.

MEDLAR ISOLATION INOCULATED INTO PEAR-SHOOTS.

Subsequent inoculations of this medlar organism into pear-shoots (with requisite controls) resulted in the production by this organism of characteristic fireblight symptoms and of ooze in fifty-one hours. The organism recovered was a short round-ended bacillus, sometimes in diplos; motile, and with the colony characters (including radiations) of the New Zealand fireblight bacillus. This bacillus is the most virulent strain I have yet isolated of New Zealand fireblight. Medlar has not previously been recorded as a host of fireblight.

PREPARING WOOL-CLIPS FOR MARKET.

LESSONS OF A RECENT SALE.

J. G. COOK, Wool Instructor, Live-stock Division.

Just prior to the wool-sale held in Wellington on 31st January last, taking advantage of the opportunity to go through the stores and observe how the wool had been prepared during the shearing season, the writer found in many cases ample confirmation of his remarks made in the last November issue of the *Journal* (p. 246), when referring to skirting and classing: "Some engage anybody to do this work, and seemingly are quite satisfied as long as the table is kept clear and the wool got out of their sight into a bale." During the inspection in the stores notes were made dividing the fleece wool under five headings, which will be described as follows:—

(1.) *Wool well skirted and well classed.*—This comprised about 15 per cent. of the fleece wool offered at the sale in question. These fleeces being free from skirtings, and the classing well done, the wool was of a good uniform character throughout the bale in each class made. By this means the buyers were able to make their valuations more easily, also with confidence, and when bidding they were able to go up to the top market price. This was fully borne out by the prices various clips realized during the progress of the sale.

(2.) *Wool well skirted but badly classed.*—This comprised about 15 per cent. of the fleece wool offered. The growers had made a great error by putting all classes of wool (with the exception of dingy and cotted) into one bale, the quality of the wool ranging from 40's up to 46's. Under this heading the farmer would have been considerably better off financially had he made the line into two classes: (*a*) Fleeces from 44's to 46's; (*b*) fleeces from 40's to 42's. Lines such as those under the above heading were the subject of much comment by the valuers.

(3.) *Wool slightly skirted but not classed.*—The wool which came under this heading comprised about 15 per cent. of the offerings. In some cases the stained part of the britch had not been removed. Other fleeces in the same bale were skirted on some of the points, but the collar-band round the neck was left on and was seedy. There had been no attempt made at classing. Cotty and dingy fleeces were included with good open wool, and the spinning-quality ranged from 38's to 46's. In these lots five classes would be required for the fleece wool, as follows: (*a*) Fleeces, 44's to 46's; (*b*) fleeces, 40's to 42's; (*c*) fleeces, 38's; (*d*) dingy; (*e*) cotted.

(4.) *Wool which had only the stained part on the britch removed, and was not classed.*—This comprised about 20 per cent. of the wool offered. Beyond the stained part being removed nothing had been done to take off the skirtings or neck-pieces, all being still on the fleece. The fleeces should have been skirted thoroughly and then classed, as mentioned for the wools under the preceding heading.

(5.) *Wool which had nothing done to it—neither skirting nor classing.*—These lots comprised about 35 per cent. of the fleece wool catalogued

for the sale. The fleeces had all the skirtings on, in some cases including belly-wool, and the fleeces were all packed together—cotty, seedy, and dingy with clean, free, open wool. This way of sending the wool for sale is all in favour of the speculative buyer, and the sheep-farmer loses every time.

If all the fleece wool had been prepared in the same manner as that which came under heading (1) the sale would have been a better one throughout. Owing, however, to there being such a wide range of quality displayed in the same bale under headings (2) and (3), those buyers who did compete for these lines put themselves on the safe side by valuing and offering the price of the lowest spinning-quality found in the bale. Several buyers crossed a number of these lines off their list and would not compete for them, several of such lines being shown to the writer. The result was that the wool-grower, through not preparing his wool properly at shearing-time, lost the competition that would have come from these buyers had it been well got up for the sale. The lines of wool comprised under headings (4) and (5) were competed for only by speculative buyers, such as those who have scouring-works of their own, where the wool is sent after being bought and then sorted out into the different classes.

The passings were very heavy right through the sale, but one could hardly wonder at this after having seen the wool when displayed in the wool-stores. More growers should come down and have a look through the stores for themselves. The educational effect would assuredly mean more care in the future when preparing the wool in the wool-shed at shearing-time. It requires reiterating that a very great sum of money is lost annually to the Dominion through such a large proportion of wool-producers not preparing their wool thoroughly before forwarding it for sale.

Milking Shorthorns for Samoa.—The Administration of Western Samoa is starting a farm with a view to supplying public institutions on the island with dairy and poultry produce, &c. For the purpose of initiating a dairy herd on the farm a consignment of Milking Shorthorn cattle was made by the Department of Agriculture to Samoa last month. The cattle were supplied by the Ruakura Farm of Instruction, and consisted of twenty heifers and one bull, Dominion Roderick.

Development of Beekeeping.—At the beekeepers' field-day held at Ruakura last month Mr. T. W. Kirk, Director of the Horticulture Division, quoted figures showing that in 1906 there were in New Zealand 74,000 colonies of bees with an output of 1,000,000 lb. of honey. Owing to a process of "cleaning out" the number of colonies was reduced in 1911 to 71,000, but owing to better methods the output increased to 1,500,000 lb. In 1916 the number of colonies was further reduced to 57,500, the output amounting to 1,400,000 lb. To-day the total number of colonies was 78,000, and the output should be about 2,000 tons. The total registrations up to last month were 5,565.

AN ECONOMIC INVESTIGATION OF THE MONTANE TUSSOCK-GRASSLAND OF NEW ZEALAND.

X. THE EFFECT OF SPELLING A HEAVILY GRAZED PASTURE IN CENTRAL OTAGO.

DR. L. COCKAYNE, F.R.S., F.N.Z.Inst.

GENERAL.

THE 300 sheep which, for the purpose of estimating the relative palatability of pasture-plants, had been grazed for thirty-two days on the pasture of the Earnscleugh experimental area of 20 acres* were removed on 23rd March, 1920. From that date, except for the presence of a few rabbits, the pasture was spelled until 27th October, 1920, when another palatability experiment was commenced. There was thus an excellent opportunity for studying the effect of spelling the pasture of a dry hillside during part of autumn, the whole of winter, and the early part of spring. Such a study derives its special importance from the fact that the Earnscleugh area, before its regrassing, was typical of many thousands of acres of depleted hillsides throughout the arid portion of Central Otago; and that, in view of the further regrassing experiments now in progress, it is essential to ascertain accurately to what extent different pasture-plants without irrigation will tolerate grazing, and their subsequent rate of growth. Evidently, too, these matters are the concern of Central Otago farmers in general, particularly as a widespread feeling exists that, lacking irrigation, little can be accomplished.

Of all the plants of the experimental area at the present time, lucerne, so far as grazing is concerned, is considered the most critical; in fact, in the opinion of many, grazing lucerne is such a ticklish business that the crop should be utilized for hay only. Now, it must be pointed out that when practical men differ there is generally reason on both sides, the differences in opinion arising rather from diverse experiences than from faulty observations. Where plants come into consideration the matter of environment must never be neglected. The conditions under which a plant is growing regulate its behaviour, and sometimes may extend its capabilities almost beyond belief. Thus, in all critical cases, there is not merely the plant to be considered, but the conditions offered by its dwelling-place, using that term in its widest sense.

In order to estimate the behaviour of the pasture under consideration during its recovery from the heavy grazing, careful attention must first of all be paid to the climate during the period of recovery and for some months prior to the grazing. Thanks to the weather record of Clyde, kept so carefully by Mr. H. E. Stevens, a good deal of the essential climatic data is available. The character and condition of the soil, equally with climate, regulate the effect of spelling. Here these matters are not gone into, for a brief account of the soil was given in this

* *Journal*, October, 1920, p. 176.

Journal for October, 1920 (p. 180), and to this the reader is referred. It will then be seen that there is no uniformity, and that, except on low flat ground, the conditions are hostile to rapid growth, while in some places the soil is chiefly small stones, and in other places the underlying rock comes very near the surface; nor must it be forgotten that the greater part of the area is extremely steep.

CLIMATE.

The climate to be taken into consideration as specially affecting the growth of the pasture after the spelling may be divided into three periods—namely, that before the grazing, that during the grazing, and that subsequent to the grazing. Although the first period to some extent affected the general moisture content of the soil, the third period specially concerned the spring growth of the pasture. Certain details intimately connected with plant-growth are unobtainable—*e.g.*, the amount of cloudy sky, the amount and velocity of the wind, the temperature on the grass, the temperature in the sun, the moisture content of the air, the amount of evaporation, and the temperature of the soil. But a general knowledge of the Central Otago climate supplies some information upon certain of the foregoing points.

Climate of Period before the Grazing (from 1st June, 1919, to 19th February, 1920—264 Days).

The total rainfall for this period was 12·25 in., and the number of days on which rain fell 52. Of this amount of rain no less than 90 per cent. fell before 29th November, only a little more than 1 in. falling from that date up to 19th February. Moreover, this inch of rain was distributed over 10 days, so that its effect in putting moisture into the ground was negligible.

In addition to lack of water from rain the high temperatures recorded for this first period would lead to great reduction in the water content of the soil. Thus for the month of November the maximum shade temperature on 8 days was above 80° F., the highest record being 86°, and, in addition, on 13 days from 70° to 79° was recorded. In December, with regard to shade temperature, on 10 days this was 90° or more, the maximum being 99°, on 10 days it was from 80° to 89°, and on 9 days from 70° to 79°, while the maximum shade temperature of the remaining 2 days was 64° and 60° respectively.

For January and up to 19th February the number of days with a maximum shade temperature of 90° and upwards was 18, the highest record being 101°; on 17 days from 80° to 89° was recorded, and the lowest maximum shade temperature was 70° on 3 days.

Climate of Period during the Grazing (20th February to 23rd March—33 Days).

Here again the rainfall was of no moment, since on 6 so-called rainy days only 0·08 in. fell. As for temperatures, the number of days with maximum shade temperatures of 90° or more, 80° to 89°, and 70° to 79° were respectively 4, 10, and 15. The absolute maximum was 92° and the lowest 62°.

In addition to the lack of rain and the frequent excessive heat from the end of November to the conclusion of the grazing (115 days), it is

FIG. 1. REGROWTH OF PASTURE-PLANTS ON THE EARNSCLEUGH EXPERIMENTAL AREA AFTER SPELLING.

In centre, tussock of tall blue-tussock, which had been eaten fairly closely, showing its poor regrowth; behind it, a plant of cocksfoot which had been eaten to the ground; and in front and to left, a strong regrowth of yarrow.

FIG. 2. REGROWTH OF LUCERNE IN THE AREA (ON AN EXTREMELY STONY SLOPE) AFTER HAVING BEEN EATEN TO THE GROUND.

[*Photos, W. D. Reid.*

safe to assume that there would be frequent and, at times, violent winds. Thus not only was the grazing carried on under peculiarly severe conditions as compared with New Zealand generally, but the supply of water in the soil for regrowth of the plants would be at a minimum.

Period of Spelling (from 24th March to 15th October—206 Days).

The number of days on which rain fell during this period of regrowth was 45, and the total rainfall 6·97 in., or about 12 in. for a year. By far the greater part of the rain (5·39 in.) fell during April, May, June, and July. In September and October, when virtually all the growth took place, there was only about 1 in. of rain.

With regard to temperature, the number of frosty days prohibiting growth must be especially taken into consideration. Taking the months seriatim, the number of frosty days (32° F. and under) was as follows: March, 0; April, 5; May, 10 (minimum 23°); June, 21 (min. 17°); July, 16 (min. 23°); August, 21 (min. 15°), September, 10 (min. 24°); October, 4 (min. 29°). Had temperatures on the grass been taken as well as the air-temperature there would have been many more records of frost, since there were frequent records of a degree or two above freezing-point.

As the remarkable rapid growth of some of the species, detailed below, took place in September and October, it is of interest to note that the number of days with maximum shade temperatures for September of 70° F. and over, and of 60° to 69°, were respectively 9 and 14; and for the 15 days of October, 3 had a maximum of 80° or more, 8 a maximum of 70° to 79°, and none had less than 64°.

EFFECT OF THE ACTUAL SPELLING.

General.

At the conclusion of the grazing (23rd March, 1920) all the highly palatable plants, except such as had been protected by their own stout stems, were eaten to the ground; indeed, the greater part of the area was bare and brown—a striking contrast to its appearance at the commencement of the experiment. The only plants which stood out conspicuously were the protected ones just mentioned, the three indigenous tussock-grasses, and red fescue, tall oat-grass, and canary-grass.

On 6th May and on 13th August I visited the area and saw very little change; indeed, on the latter occasion it certainly looked as if the pasture would not be sufficiently recovered to permit grazing again much before Christmas. During the autumn there had been a small amount of growth, but comparatively little of this was to be seen in August. Even at the end of the first week in September growth had not commenced. But from that time onwards growth set in at a great pace, thanks to the warm weather, so that by 10th October, or earlier, the whole area was more or less covered by vegetation and green in hue. On the more open ground this was due, in large measure, to the great quantity of annual species. Such also clothed what had been bare slopes on the adjacent sheep-runs, so this particular portion of the pasture had really nothing to do with spelling; nevertheless, as this vernal annual vegetation of arid Central Otago is most important with regard to the early feeding of stock, a list of the commoner constituents

FIG. 3. REGROWTH OF CHICORY WHICH HAD BEEN EATEN TO BELOW THE SURFACE OF THE GROUND.

FIG. 4. REGROWTH OF COCKSFOOT WHICH HAD BEEN EATEN TO THE GROUND.

Photos. W. D. Reid.

should be of interest. These are: the wild geranium, or hemlock-storksbill (*Erodium cicutarium*)—a plant of high palatability; annual fescue (*Festuca myuros*); soft brome-grass (*Bromus hordeaceus*); sterile brome-grass (*B. sterilis*); barley-grass (*Hordeum murinum*); lesser nettle (*Urtica urens*); haresfoot trefoil (*Trifolium arvense*); forget-me-not (perhaps *Myosotis arvensis*); and certain inconspicuous annuals—*e.g.*, the indigenous lesser mousetail (*Myosurus aristatus*), an introduced buttercup (*Ranunculus falcatus*), and the indigenous dwarf forget-me-not (*Myosotis pygmaea*).

Certain species not particularly noticeable at the grazing-period were far more in evidence, not because they had greatly enlarged their area of occupation, but because their new green leaves rendered them more conspicuous. To this class belong yarrow (*Achillaea Millefolium*) (see Fig. 1, on the left); red clover (*Trifolium pratense*), and sheep's burnet (*Poterium Sanguisorba*).

The most striking feature of the regrowth was the astonishing recovery of lucerne (*Medicago sativa*), which, to use a familiar phrase, had had "the heart eaten out of it." It is grazing of this description which is popularly supposed to kill out lucerne altogether. Here, however, the contrary had occurred: no lucerne whatsoever had been damaged in the slightest degree (Fig. 2).

Cocksfoot (*Dactylis glomerata*), which had been grazed quite as heavily as the lucerne, had also grown well; but where it had been mown in the early summer prior to the grazing the amount of food produced was not great, and in a few cases plants had been actually killed, while others were not sufficiently recovered to tolerate heavy stocking.

At the close of the grazing, yarrow, chicory, and catsear had not merely been eaten to the ground, but the underground stems or roots had been attacked. Nevertheless, all three species showed no signs of this excessive grazing, but they offered food in abundance (Fig. 3).

With regard to the indigenous tussock-grasses, blue-grass (*Agropyron scabrum*) and tall blue-tussock (*Poa intermedia*), which had been eaten more or less, the former had in many cases produced a good deal of fresh growth, but the regeneration of the latter was extremely feeble (Fig. 1).

Special Details.

Measurements of the actual amount of growth were taken in several occasions throughout October. In what follows the measurements taken on the 15th October, 1920, are given, unless the contrary be stated.

Annual Fescue (Festuca myuros).—This grass was abundant throughout; its height was 6 in., more or less.

Birdsfoot Trefoil (Lotus corniculatus).—Individual plants were about 6 in. to 10 in. diameter and 5 in. to 8 in. high.

Bladder-campion (Silene inflata).—This must have come in as an impurity in certain seeds. At the time of the grazing it was not noticed. The shoots were 7 in. to 9 in. long.

Blue-grass (Agropyron scabrum).—As pointed out in the December, 1920, number of this *Journal*, there are many forms of this grass even in the neighbourhood of Clyde, while on the Earnscleugh area itself possibly half a dozen different varieties could be found. These varieties

FIG. 5. LUCERNE TUSSOCK THE ENTIRE GROWTH OF WHICH HAD TAKEN PLACE BETWEEN 8TH SEPTEMBER AND 16TH OCTOBER.

FIG. 6. PLANT OF SHEEP'S BURNET, SHOWING ITS REGROWTH.

[*Photos, W. D. Reid.*

differed greatly in their rate of regrowth—*e.g.*, a form with broad leaves grew far faster than any other. Also plants eaten to the ground had made stronger growth than those partially eaten. Speaking generally, some had grown very little, while others had produced abundance of green leaves 4 in. long or even longer. In the small enclosure, which was not grazed during the second palatability experiment of October, 1920, blue-grass plants eaten in February had produced a good deal of excellent green feed by the end of November. Most of the uneaten plants had also grown well, and there were fine, bright-green tussocks more than 12 in. through, with broad, flat leaves quite 17 in. long. To one accustomed only to the straggling growth of blue-grass in tussock-grassland in general, mostly hidden in fescue-tussocks, these splendid green tussocks were a revelation. The form of blue-grass with creeping underground stems is of considerably weaker growth.

Canary-grass (Phalaris (commutata) caerulescens).—Probably about 7 in. would be the average growth, but it was not easy to estimate, for there is not much of this species on the area, nor had it been eaten to any noticeable extent.

Catsear (Hypochoeris radicata).—At the conclusion of the grazing this looked as if it could not recover. But over all the area, at the period of its examination, catsear was abundant, and there were many seedlings. Generally the rosettes of leaves were flattened to the ground, their diameter being 2 in. to 3 in. But there were plenty of larger plants with leaves up to $2\frac{3}{4}$ in. long or more. By 16th November, in the ungrazed small enclosure, plants with leaves over 3 in. long were common.

Chewings Fescue (Festuca rubra var.*).*—Like all species not eaten closely, the actual regrowth was difficult to estimate, but apparently 2 in. to 3 in. was the rule. Also seedlings had been abundantly produced.

Chicory (Chicorium intybus).—The recovery of chicory after being eaten to below the surface of the ground was remarkable. Many leaves measured $4\frac{1}{2}$ in. long by $1\frac{1}{2}$ in. broad, but there were some far longer (Fig. 3).

Cocksfoot (Dactylis glomerata).—There were two classes of this extremely palatable species—namely, those protected by the old dead stems and those which had been eaten to the ground. Shoots of the former measured up to 12 in. long (Fig. 4), while those of the latter generally ranged from 4 in. to 6 in. Where grazing had been excessive the old, dry leaf-sheaths were visible, but in a majority of cases the plants were quite green and growing vigorously. In a few instances plants had been killed outright, and in other cases recovery was proceeding very slowly. The plants which had suffered were those that had been mown in the early summer prior to the grazing. Plants in the small enclosure, which had been eaten to the ground, had reached a height of from 10 in. to 18 in. by 16th November. In certain places much cocksfoot seed germinated, and a good many young plants survived the winter.

Dandelion (Taraxacum officinale).—This species was not noted at the time of the grazing, for the plants would be quite burnt up. On 15th October a good many plants, mostly in bloom, with leaves up to 6 in. long, were dotted about here and there.

Fescue-tussock (Festuca novae-zelandiae).—It may be remembered that this, easily the commonest tussock of the upland sheep-pastures throughout the South Island, had hardly been eaten. On 13th October the plants were still brown and had produced very few young green leaves.

Lucerne (Medicago sativa).—My notes, taken during an examination of the area on 13th August, read: "Lucerne looks dead, but apparently most is alive." Certainly this did not give any hint of the marvellous recovery in the spring.

By 15th October plants 18 in. high were not uncommon, but the average would be a little more than 12 in. On the lower third of the extremely stony slope facing north-east the young shoots varied from 9 in. to 18 in. in length, with an average of about 14 in. (Fig. 2).

The plants had the tussock form, and such were often more than 16 in. diameter and of extremely close growth. Towards the summit of the slope the growth was smaller, but even there shoots 13 in. long were noted. Isolated plants were larger than those growing close together, one of the former measuring 19 in. by 22 in. by 17½ in. high (Fig. 5). The plants growing on the best soil were not quite as large as those on the lower part of the stony ground. Later on, according to most careful measurements, certain plants showed a growth of 6 in. and more in 7 days—*i.e.*, within one week's time from the examination on the 16th October a good many were more than 2 ft. high. In some places seedlings were produced in considerable numbers.

Meadow-grass (Poa pratensis).—This grass had come on more slowly than most of the other plants, so that it did not offer much feed. Some leaves measured from 2 in. to 4 in. long, and even 6 in. was reached, but there was no general close growth.

Ox-eye Daisy (Chrysanthemum Leucanthemum).—There was very little of this species. New shoots measured 2½ in. long.

Red Clover (Trifolium pratense).—There was not much red clover. The growth was far less than that of lucerne, the maximum recorded for the shoots being only 4 in.

Red Fescue (Festuca rubra var.*).*—This had been but little eaten; young leaves 4½ in. to 6 in. long were noted.

Red-top (Agrostis vulgaris var.*).*—This showed hardly any growth; the dead leaves were greatly in evidence.

Rib-grass (Plantago lanceolata).—Growth had been fairly vigorous, the average length of the leaves being about 3½ in.

Sainfoin (Onobrychis viciaefolia).—The few plants in the pasture had grown well, but I have no exact measurements.

Sheep's Burnet (Poterium Sanguisorba).—This herb has greatly increased in amount since it was originally sown. Plants frequently measured 5 in. to 6 in. high (Fig. 6), and leaves were from 3 in. to 5 in. long; some plants were coming into flower. Seedlings were abundant.

Soft Brome-grass (Bromus hordeaceus).—As a rule this annual grass was about 6 in. high.

Sorrel (Rumex Acetosella).—There were great differences in the growth of this herb. Many plants had quite small leaves, but in other cases they were ¾ in. or more in length.

Sweet Vernal (Anthoxanthum odoratum).—Young shoots measured from 3 in. to 6 in.

Tall Blue-tussock (Poa intermedia).—The growth of the few tussocks which had been eaten was very slight. Fig. 1 gives a fair idea of the position of this widespread indigenous grass with regard to recovery after fairly heavy grazing.

Tall Fescue (Festuca elatior).—This had been eaten slightly during the grazing. Shoots measured from 10 in. to 15 in., but perhaps these figures exaggerate the spring growth.

Tall Oat-grass (Arrhenatherum elatius).—As this had been eaten to a very small extent during the grazing it was not feasible to estimate the rate of recovery. Shoots measured from 10 in. to 15 in. long.

Twitch (Agropyron scabrum).—This is one of the many grasses also called "couch." The shoots varied from 5 in. to 8 in. in length, and the leaf-blades were 3 in. to 5 in. long.

Vetch (Vicia sp.*).*—Considering its climbing habit the growth, 6 in. to 8½ in., cannot be considered great.

Wild Geranium, or Hemlock-storksbill (Erodium cicutarium).—This extremely valuable spring annual pasture-plant varied considerably in size, but the shoots, more or less flattened to the ground, were often over 4 in. long. The plant occurred in great abundance and was in full bloom.

Winged or Star Thistle (Carduus pycnocephalus).—The young plants of this large annual herb were of various sizes, the largest having broad tender leaves about 7 in. long.

Woodrush (Luzula campestris var.*).*—This indigenous grasslike plant, which had been closely grazed, had hardly made any growth.

Yarrow (Achillaea Millefolium).—Notwithstanding this herb having been eaten right to its underground stems, it had grown vigorously and formed many large green patches of leaves 1 in. to 7 in. long.

Yorkshire Fog (Holcus lanatus).—Most of the plants had grown fairly well, but much stronger growth occurred later, so that in the small enclosure, by 15th November, many had shoots about 10 in. long.

Teachers' Farm School at Ruakura.—Speaking at the recent Teachers' Farm School at Ruakura Farm of Instruction, Mr. A. H. Cockayne, Biologist to the Department, said that the great success of these schools was having a very considerable influence in moulding the future policy of the farm, which would soon be put on a sound basis for a very considerable extension of such work. It was the intention of the Department to establish at Ruakura a properly equipped farm school for the teaching of the very best practices in modern agriculture, and at which teachers and farmers could take periodical short courses. In this manner the value of the farm from an educational aspect would be greatly advanced. When in America he was much impressed with the very great importance that was attached to schools of this descript on over there, and he had seen nothing in the United States to compare with Ruakura in management and suitability for short-course work.

THE WERAROA FRIESIAN HERD.

ITS FOUNDATION AND DEVELOPMENT.

W. J. McCULLOCH, Manager, Central Development Farm, Weraroa.

THE Weraroa herd of Friesian cattle was initiated in 1909, during the managership of Mr. James Drysdale, by a selection from the Longbeach herd of Mr. J. C. N. Grigg, in Canterbury. The latter herd, as is well known, had been founded by direct importation from Holland. The first consignment from Longbeach consisted of twenty heifers, and these were headed by the imported bull, Sir De Kol Inka Pietertje, purchased from Mr. Newton King, New Plymouth. In the following spring a further selection of eight females was made from the Longbeach herd. This selection comprised the subsequently noted cows, Domino III, Spot IV, Flower, Longbeach Daisy, Buttercup IV, Molly, Domino IV, and Domino V. The progeny of these cows is widely represented in the Dominion to-day.

The next addition made to the herd was a selection of five heifers made by Mr. Drysdale in Australia in 1910. Two of these—Mierlo and St. Gertrude's—were obtained from the State farm at Berry, New South Wales. A further two—Pride II of Brundee and Anna of Brundee—were obtained from Mr. Lamond, of Nowra. Mierlo and Pride II of Brundee are still in the herd at Weraroa and going strong.

With the purpose of further improving the herd a further addition was made in 1911 by the importation of three heifers and a bull selected for the Department by ex-Governor W. D. Hoard, of Wisconsin, U.S.A. This consignment consisted of two heifers—Jessie Fobes Beets and Lady Blanche de Kol Homestead—and the bull Oak de Kol II Homestead Fobes; also the heifer Mutual Mercedes of Rock, from Mr. John Hetts, Fort Atkinson, Wisconsin.

Further fresh blood was introduced in 1912 by Mr. W. M. Singleton's selection in America of four heifers—Woodcrest Daisy, Woodcrest de Kol Cornella, Woodcrest Ida Fayne, and Woodcrest Aaggie Grace, and the young sire Woodcrest Joe. These were all obtained from Mr. Dimick's Woodcrest Farm, Rifton, New York.

More recently the bulls Longbeach Primrose League and Longbeach Big Patch, bred by Mr. Grigg, were added to the herd, this completing the purchases.

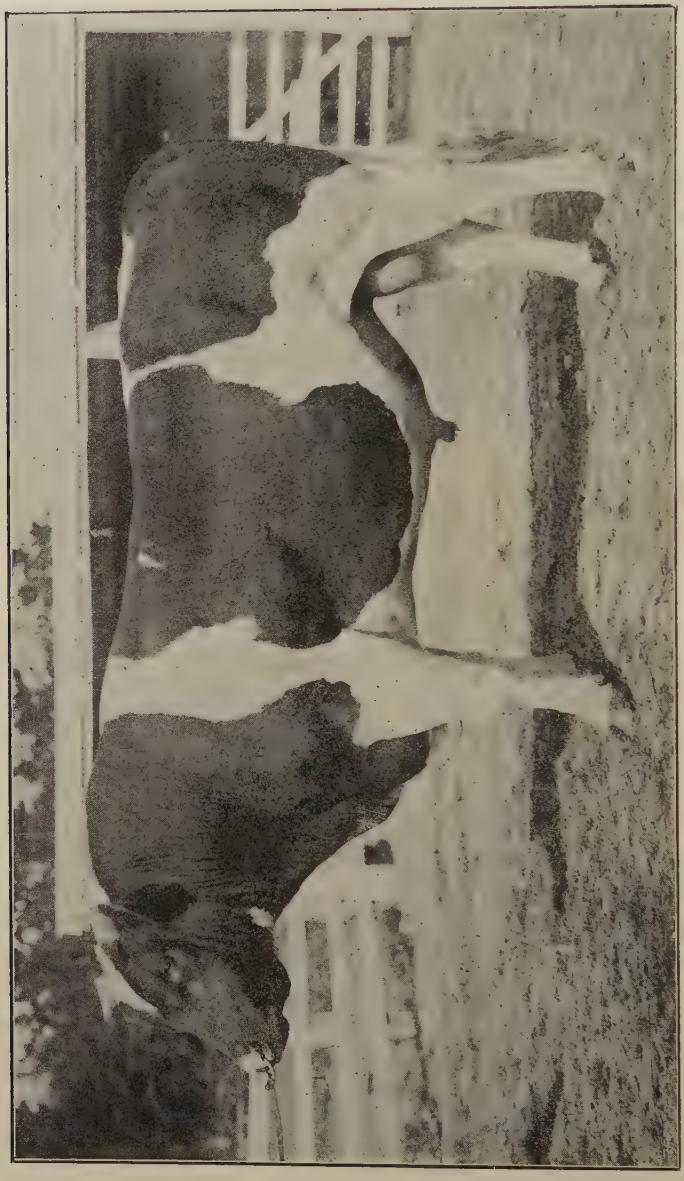
In early years many breeders in New Zealand were of opinion that the Longbeach Dutch type would not blend satisfactorily with the specialized American dairy type of Friesians. This view, however, has been amply disproved by the results obtained at Weraroa, as the progeny bred on these lines have been heavy-producing cattle of good constitution and type. As illustrating this fact it may be of interest to give a few examples of production during the eleven years the herd has been in existence. A number of the earlier results were necessarily farm records, the period being before the days of the semi-official

DOMINO III.

Representing the Longbeach Dutch type.

DOMINION MUTUAL MERCEDES OF ROCK.

Representing the American type.



DOMINION OAK DE KOL II HOMESTEAD FOBES.
Imported from America in 1911.

testing system. It may be mentioned that the Weraroa Friesians were the first to be systematically tested in New Zealand.

Name of Cow.	Season.	Days.	Milk.	Butterfat.
			lb.	lb.
Manola	1910–11	334	15,217·00	578·20*
Domino III	1911–12	365	21,402·00	757·00*
Spot IV	1911–12	365	15,299·00	688·35*
Lurli	1911–12	365	15,709·25	469·70*
Pride II of Brundee ..	1917–18	365	17,879·00	559·33
Mierlo	1919–20	324	14,911·00	489·61
Jessie Fobes Beets ..	1917–18	343	15,474·00	545·80
Mutual Mercedes of Rock	1915–16	332	14,649·00	529·76
Fayne	1919–20	365	14,420·00	477·32
Woodcrest de Kol Cornella	1912–13	365	16,864·00	583·30
Woodcrest Daisy ..	1919–20	359	14,872·25	481·89

* Farm records.

These are representative records of the foundation cows. The following are some of the records of progeny bred at Weraroa :—

Name of Cow.	Season.	Days.	Milk.	Butterfat.
			lb.	lb.
Olga	1913–14	365	16,168·00	611·00
Domino's Pride	1914–15	365	12,688·50	472·75
Olga II	1918–19	365	16,800·00	562·81
Blanche Frisby	1919–20	313	14,065·50	510·36
Jocrest	1919–20	357	15,294·75	539·00
Lavender	1919–20	365	14,999·25	563·46
Pauline	1919–20	365	16,012·50	531·19
Doreen II	1919–20	331	12,887·70	474·14
Margaretha	1918–19	365	13,557·50	427·15
Lady Tromp	1919–20	325	13,097·75	450·29
Azalea	1918–19	365	14,805·00	450·98
Beauty	1918–19	365	12,688·00	425·49
Johanna Aaggie	1919–20	342	12,822·25	418·54
Anemone	1919–20	291	11,429·00	402·99

All the above records are from twice-a-day milking, with no special feeding or attention given to the respective cows, which were running in herds of fifty and over. At time of writing the average production of the females retained in the milking-herd is slightly over 502 lb. of butterfat, for twenty cows and heifers under C.O.R. test.

It should be noted that the Weraroa-bred cows whose records are given represent in the majority of cases a blend of Longbeach and American blood. In addition to being good producers they are also of excellent breed-type. This was recognized at the last Manawatu show, when a yearling heifer by a son of Woodcrest Joe (imp.) and Mutual Mercedes of Rock (imp.) out of Domino's Pride (the latter of pure Longbeach blood, being by Longbeach Van Tromp out of Domino III) won the special yearling prize in a class of over twenty entries. Weraroa has had very good results from the American imported stock. Two sons of Woodcrest Joe (imp.), which are now being used as stud bulls, also gained the championship and reserved championship at the same Manawatu show.

EXPERIMENTS WITH "RADIO" MANURE.

THE EFFECT OF COALDUST ON CROPS.

T. H. PATTERSON, H.D.A., Instructor in Agriculture, Auckland.

THE maintenance of the fertility of the soil is a matter of vital importance to the farmer. Next to cultivation there should be no subject of more interest to him. While good cultivation helps to set free reserves of plant-food held in unavailable form in the soil, it is found necessary, except possibly with the very best soils, to supplement the available supply by the addition of readily soluble forms such as we find in artificial fertilizers. The farmer in the Auckland Province, as in many other parts of New Zealand, is dependent in no small measure upon artificial fertilizers to maintain the fertility of his soil. The evident decrease of fertility, which one cannot help noticing when travelling through districts where the soil has been cropped for a number of years; the difficulty of procuring ordinary farm labour, and the advanced cost of it; and the high prices of land, seeds, fertilizers, and machinery combine to force the farmer who is desirous of securing the best results to consider carefully the fertilizer or manurial mixture most suitable for his soil and crop requirements.

During the war period there was a shortage of well-known and tested lines of imported fertilizers. Among them high-grade basic slag was at times unprocurable, particularly towards the end of the war. New lines of fertilizers of local manufacture have been put on the local market since the outbreak of the war. One of these, known as "Radio," is not new to farmers in the Auckland Province. It is composed of a small amount of readily available phosphate, burnt lime, and coaldust (Taupiri brown coal). It is claimed that it is radio-active. Results in England, as summed up recently by Dr. E. J. Russell, of Rothamsted Experimental Station, show that, so far as present knowledge goes, there is no clear evidence of increased growth due to the application of radio-active materials to the soil. This eminent authority is here referring in his book, "Soil Conditions and Plant Growth" (pp. 54–55), to laboratory experiments and field trials carried out by research workers and others, including Dixon and Wigham, Baker, and Martin H. F. Sutton. If we accept these results as conclusive—which we must do for the time being—then the claim of Radio manure to radio-activity is valueless agriculturally.

TESTS WITH AUTUMN-SOWN GRASS AT MOTUIHI.

With the object of testing the utility of Radio manure as a fertilizer for pasture establishment, half-acre plots were set out last year on Motuihi Island, off Auckland Harbour, and it was used at the rate of 3 cwt. per acre with autumn-sown grass. The trials included check plots which received no manure, and others which were treated with fertilizers of known and proved value. The soil of the field on which the trials are now in progress is a medium to heavy loam possessing a fair amount of humus, and overlying a clay subsoil. The cropping previous to preparation for pasture last autumn was oats for chaff. The area had received a little lime, but virtually no manure. For all practical purposes it could almost be considered virgin land.

The mixture of seeds used, giving quantities per acre, was as follows: Cocksfoot, 12 lb.; perennial rye, 8 lb.; Italian rye, 5 lb.; crested dogstail, 4 lb.; Chewings fescue, 4 lb.; red clover, 2 lb.; white clover, 2 lb.; alsike, 2 lb. The total seeding of 39 lb. per acre was sown on 29th March, 1920.

While the value of lime and superphosphate, applied separately or in combination, is well known to every farmer, it was necessary to test the value of a combination of coaldust with each of those materials. Hence there were included in the trials, plots on which dressings were made of superphosphate and coaldust, and lime and coaldust, and also a plot with superphosphate and lime. The amount of each ingredient was in the proportion in which it enters into the composition of Radio manure, and the quantity applied was the equivalent of that of a dressing of 3 cwt. of Radio per acre. Plots were also set out using coaldust, lime and superphosphate separately, and quantities applied in the proportional amounts found in the Radio mixture, the rate being calculated in each case on 3 cwt. per acre. The Radio Manure Company supplied the formula, and also the manures free of cost. Moreover, their representative agreed that the field trials, as set out and conducted, met with his approval. He considered that 3 cwt. of Radio per acre was an adequate dressing to apply with autumn-sown grass.

The pasture was grazed with sheep in the spring, and was shut up later to allow of comparisons being made in the yields of the various plots. The plots were cut and weighed as green-stuff on 9th December, the proportion of grasses to clovers being estimated from an enclosed area of 14 ft. square on each plot. The rainfall for the year, taken at Auckland, was 58·17 in., which is above the average annual fall. The table on next page shows the results of the trials for the first year. The Fields Instructor's remarks are given in the column on the right. These observations were made on the standing crop just before the plots were harvested.

To make comparisons readers should look down the column showing the percentage yield. These estimations were made using the method adopted by the New South Wales Department of Agriculture, and considered there, as in other parts of the world, a reliable means in carefully conducted field experiments of reducing the experimental error which may creep into such trials on account of variations in soil, cultivation, seeding, and so forth. The check or control plot in each case is reckoned as 100 per cent., which gives the natural yield and provides a basis for comparison.* Radio in one case (plot 2) gave 19·8 per cent.

* There are differences, it will be observed, in the yields of the check plots, which are assumed to be due to the gradual increase or decrease in the fertility of the soil. Looking at the actual yields from check plots 1 and 6, there is a decrease of fertility from the first check to the next. On the other hand, we would assume that there was a gradual increase in fertility from check plot 6 to check plot 10. The natural yield referred to is that which any plot would have yielded had it been a check plot. The natural yield of any plot therefore is the actual yield of the adjacent check plot, plus or minus an amount calculated by dividing the difference between the nearest check plots by the number of plots from one check to the next. For example, we have five plots after plot 1, which brings us on to the next check plot—No. 6. The difference in yield between these check plots is 15 cwt. 3 qr. 14 lb., and one-fifth of that is 3 cwt. 19·6 lb. This latter amount, if subtracted successively from the actual yield of check plot 1, will give the natural yields of plots 2, 3, 4, and 5 respectively. The percentage yield is the percentage of the actual yield to the natural yield. The method may perhaps appear a little involved, but it gets nearer to the truth than any other the writer is aware of, especially when plots are not duplicated or further multiplied.

MANURIAL EXPERIMENT WITH AUTUMN-SOWN GRASS AT MOTUIHI, 1920.

Plot No.	Fertilizer used.	½ Yield of Green-stuff per Acre.	Percentage Yield.	Proportion by Weight of Clovers to Grasses (approximate).	Remarks on Standing Crops.
		T. cwt. qr. lb.			
1	Check (no manure)	5 19 0 7	100·0	2·0 to 1·0	Only fair. Grasses thin. Not much red or alsike clover.
2	Radio, 3 cwt. per acre ..	6 18 3 17	119·8	2·1 to 1·0	Better than plot 1. More even distribution of clovers and grasses.
3	Superphosphate	7 6 3 10	130·3	2·3 to 1·0	Proportion of rye-grasses, crested dogstail, and clovers very good. Thick covering.
4	Burnt lime	4 3 1 10	75·9	1·0 to 1·5	Evenly distributed plant-covering, but thin. Poorer than check plot. No red clover.
5	Coaldust	4 11 1 3	85·8	1·1 to 1·0	Very poor proportion of grasses and clovers. Mostly trefoil. Thin covering.
6	Check (no manure)	5 3 0 21	100·0	1·1 to 1·0	Poor growth of rye-grasses and crested dogstail to clovers.
7	Superphosphate and burnt lime	8 8 2 19	146·5	3·7 to 1·0	Strong growth of rye-grasses and crested dogstail. Clovers good.
8	Coaldust and superphosphate..	7 16 3 1	120·6	3·6 to 1·0	Only fair growth of rye and other grasses. Red and alsike clovers fair; trefoil fair.
9	Coaldust and burnt lime ..	6 2 3 1	82·9	2·7 to 1·0	Poor, thin growth of grasses. Clovers better.
10	Check (no manure)	7 16 3 2	100·0	3·0 to 1·0	Very fair growth of grasses and clovers. Trefoil good.
11	Radio, 3 cwt. per acre ..	7 16 3 2	100·0	3·0 to 1·0	Fair growth of rye-grasses and crested dogstail. Very little red and alsike clovers. Mostly white clover and trefoil with grasses.
12	Ephos basic phosphate, 3 cwt. per acre	8 12 2 25	110·1	1·6 to 1·0	Good strong growth of rye-grasses and crested dogstail noticeable. Very little red, but mostly alsike and white clovers, with a fair amount of trefoil.
13	Ephos, 1½ cwt. per acre; superphosphate, 1½ cwt. per acre	10 0 1 19	127·8	3·5 to 1·0	Very good growth of rye-grasses and crested dogstail. Alsike, red and white clovers good. Mixture of trefoil good. On the whole a good dense covering.
14	Basic superphosphate, 1 cwt. per acre; bonedust, 1 cwt. per acre; guano, 1 cwt. per acre	8 18 2 10	113·9	5·6 to 1·0	Only a fair proportion of rye-grasses and crested dogstail. A very good mixture of red, white, and alsike clovers. Trefoil good.

NOTE.—The amount of each ingredient in plots 3, 4, 5, 7, 8, and 9 was in the proportion in which it enters into the composition of Radio manure, and based on a dressing of 3 cwt. of Radio per acre.

over and above the check plot. In the other case (plot 11) it yielded the same as the check plot. Taking the average of the two Radio plots, it will be seen that the yield was 9·8 per cent. over and above the check plot. Superphosphate alone (plot 3) gave 30·3 per cent. over and above the check plot, and superphosphate with lime (plot 7) gave 46·5 per cent. in excess of the check. It will be noticed that in every case where coaldust was used it lowered the yield appreciably. Superphosphate and coaldust (plot 8) gave a lower yield that superphosphate alone, and much lower than superphosphate and lime combined; while Radio gave a lower yield than either superphosphate alone or superphosphate and lime combined. Burnt lime (plot 4) gave a lower yield than the check plot, which may be due possibly to the fact of it diminishing the soil-moisture in close proximity to the seed. Burnt lime, which is caustic, may be harmful to seeds. It would not have these effects when it was chemically combined with the acid superphosphate, as its properties would be altered. Moreover, it would then, as anticipated, tend to increase the yield, as happened on plot 7.

The illuminating fact, so far as can be judged from data supplied by the first-year trials, is that coaldust has a depressing effect on the grasses and clovers. It would be better practice to use superphosphate alone or combined with lime than to use a mixture in which coal-dust was an ingredient. The reason, possibly, why coaldust has this depressing effect is that it contains sulphides which are known to be detrimental to plant-growth.

TOP-DRESSING EXPERIMENTS AT ALBANY.

On a pasture in a field adjoining the Albany gum-lands demonstration area, about nine miles from Auckland, six plots were set out in June of last year. The area of each plot was three-tenths of an acre. The pasture was laid down some years ago, and is of considerable age. The soil is of the better-class gum-land type, as stiffish loam with a small proportion of humus.

Unfortunately, we were unable to obtain reliable data for the season from these plots, as the property is leased for grazing, and the owner found it inconvenient to remove all his sheep from the area in time to shut it up in order to allow the plots to be cut and weighed, as was done at Motuihi Island. However, from observations made during the progress of the trials, the plot that had received basic slag in August, 1920, at the rate of 3 cwt. per acre, looked best. Next in order was a plot that had been limed in June, 1920, and 3 cwt. superphosphate per acre applied at the same time as the basic slag on the previous plot. Very close for second place was the plot that was ranked as third. It had received equal parts by weight of superphosphate and basic slag at the per-acre rate of 3 cwt. Basic super, Adelaide guano, and steamed bonedust in equal quantities by weight, up to 3 cwt. per acre, was fourth. Of the remaining two plots Radio manure, at 3 cwt. per acre, was a shade better than the plot with equal quantities by weight of ground Makatea Island phosphate and carbonate of lime. The Makatea phosphate was not very finely ground. The two last mentioned, as far as one could judge by eye inspections throughout the season, were little better than the control plot, which received no manure. Next season the intention is to shut up the area and cut the plots separately to

obtain the yields by weight of green-stuff, when more reliable comparisons can be made.

CONCLUSION.

The writer, in the course of his investigations, in order to arrive at a fair estimation of the value of Radio as a fertilizer, visited a number of farms in Waikato and other parts of the province where Radio had been used. The manure is held in esteem by many of the farmers who have used it, and who were consulted. In view of the results obtained so far by the systematic and carefully conducted trials here outlined Radio cannot claim its value from the coaldust used, but from the phosphate and lime it contains. Moreover, as indicated above, the addition of coaldust affects adversely the good effect of the other ingredients. These trials will be continued for a couple of seasons longer, when more complete and conclusive results should be available. It may be mentioned that Radio manure is quoted at £6 15s. per ton, f.o.r., Claudelands, Hamilton.

NOTE.—Following are the analyses of fertilizers used in the foregoing experiments as made by the Department's Chemical Laboratory:—

Radio: 0·8 per cent. insoluble nitrogen; 4·5 insoluble phosphoric anhydride (P_2O_5).

Superphosphate: 17·6 per cent. soluble and 1·4 per cent. insoluble phosphoric anhydride.

Ephos: 29·6 per cent. insoluble phosphoric anhydride.

As regards the question of radio-activity, laboratory tests carried out at Wellington last year showed that less radio-active ingredients were present in Radio manure than in ordinary Wellington soil.

COB OR EARTH BUILDING.

J. R. MARKS, A.M.I.C.E., Public Works Department, Alexandra.

IN Central Otago, where the average annual rainfall is only between 12 in. and 18 in., but with extremes of heat and cold, and where building and other materials are scarce and expensive, cob or earth has been used for buildings of all descriptions since the start of settlement, while some people are still using it for residence solely on account of its low heat-conducting qualities. This system of building is inclined to be revived at present, owing to the high cost and difficulty of obtaining timber, and there is a considerable demand from various directions for information on the subject.

TYPES OF COB BUILDING.

There are three distinct types, which may be briefly described as follows:—

Dry cob: Choose a light subsoil, free from much gravel or sand, but yet not clay. Discard the surface humus, and dig out the subsoil as required for the walls. Turn dry subsoil on a mixing-board, sprinkling with water in a similar manner to concrete, and when slightly damped throughout place between wall-moulds in 2 in. or 3 in. layers and ram well. Two boards bolted together form moulds for walls, and are

moved as soon as filled. Holes left in the walls by the bolts are filled with mud. No straw is used in this work, and almost any soil appears to suit.

Wet cob: Choose material in the same way as for dry cob. Dig up a circular strip 2 ft. or 3 ft. wide and about 20 ft. in radius. Puddle the dug material by applying water and driving a horse round in it. When partly puddled, add about 2 per cent. of straw or tussock and trample this in with the horse. When the material is about the consistency of workable putty dig it out and place it in walls in the same manner as for dry cob, and ram similarly. Wet cob is inclined to develop cracks in drying out, but these, when once filled with mud mortar, give no more trouble.

Sun-dried brick: Prepare puddle exactly as for wet cob, but instead of building in mass mould the material into bricks 15 in. by $7\frac{3}{8}$ in. by 6 in. alongside of puddling-ground. The mould can be removed from the bricks an hour after making, and the bricks can be used in a week's time, being built to any recognized bond and jointed with mud mortar, the latter preferably to be slightly more sandy than material used for bricks.

General: In all cases foundations should be made of stone in mud or cement mortar, or of concrete brought 9 in. above ground-level, and, after being topped with a 3 in. layer of wet or dry cob, finished with a damp-course ready to start building walls. The cheapest damp-course and one quite efficient can be made with a $\frac{1}{4}$ in. layer of tar and sand. Walls are usually built 15 in. thick and solid. Window and door frames are built into the walls as the work proceeds. A good overhang should be given to eaves all round to keep weather off walls as much as possible.

It is more usual to leave walls without any outside dressing in any of the three classes described, but they can be given a better appearance and will probably last longer by applying one coat of whitewash, consisting of one part cement to three parts lime, mixed with water, or two coats of raw linseed-oil, coloured if desired. Plaster on the outside is inclined to lift with frost. The inside can be left undressed or finished the same as outside, or it will take cement plaster the same as burnt brick.

OTHER PARTICULARS.

Lasting-qualities: Undressed wet- and dry-cob walls in Central Otago, over thirty years old, appear the same as new where care has been taken not to allow spouting to get out of order. Sun-dried brick is of more recent construction, but shows no appreciable deterioration after twenty years. There does not appear to be much difference in the lasting-qualities of the three methods.

Comparative costs: Dry cob is said to be only about two-thirds of the cost of wet cob or sun-dried brick, while the two latter are almost equal in cost. A wet cob or sun-dried brick building would probably cost about two-thirds of the cost of a similar building in timber, because the floors and roofs and fittings are the same in any case.

Preference: Experienced builders favour sun-dried bricks as being the quickest to erect (after the bricks are made), better in appearance, and stronger on account of non-liability to crack if properly bonded. At times when damp air and frosts will cause moisture to sweat through a stone wall, so that it can be wiped off inside with the hand, sun-dried brick walls are found to be quite dry.

SUPPLEMENTARY FORAGE-CROPS.

W. DIBBLE, Fields Instructor, Auckland.

SUMMER FORAGES.

An old worn-out pasture that requires renewing may with advantage be devoted to the production of a course of summer forage-crops. For this purpose the land should be ploughed in the late autumn, and permitted to lie exposed to the rain and atmosphere during the winter months. In the spring cross-plough and subsoil as deeply as the land will allow, and later, when the time for sowing is near, work down with disk and harrows until the seed-bed is made as fine and friable as possible. The extent to which the roller can be used at that period of the year can only be decided at the time and on the spot. The simplest way to determine whether it is advisable to roll cloddy ground is to kick some of the clods. If the clods fall apart the roller may be used, but if they are difficult to break and the ground is at all moist the roller should not be employed. Rolling is not satisfactory if the clods are merely forced into the soil without being broken up, for this only results in a hard crust being formed on the surface. Depth of cultivation, thorough preparation of the land, and a fine mellow seed-bed are all-important.

If after a few days there appears to be a superfluity of water in the soil it is an indication that the land requires draining. Waterlogged land when it does dry loses nearly the whole of its moisture by evaporation. On the other hand, the small particles in a friable soil check capillary action, and thereby prevent undue evaporation, the soil remaining moist long after sodden parts of the field have become as hard as a brick. If drainage is required it should be done, as it pays, and pays handsomely. Drainage has an intimate relation to soil-moisture. By drainage is meant the means employed for the removal of the surplus free water. Surface or open ditches may serve to carry off surface water, but as soil-drainers they function imperfectly. The correct method for removing the surplus water of rainfall is to cause it to sink into the soil and be removed by underdrains.

The following course of summer forages will be found of valuable assistance to farmers, and especially dairymen who desire to keep up a good steady supply of milk during the season, when the grass pastures may be dried up or lack succulence.

For a dairy herd of from sixty to seventy in number sow 5 acres of oats and grey spring tares about the second week of October, at the rate of 2 bushels of oats and 1 bushel tares to the acre. These should be ready for feeding in January, and if not required can be utilized for hay or ensilage. In the first week of November sow 4 acres with soft turnips—purple-top Mammoth, Imperial Green Globe, or Lincolnshire Red. These should serve for February and March feeding.

In addition to the foregoing, sow between the third week of November and the second week of December from 5 to 8 acres of any of the forages on the list which follows. These crops, which are all worthy of a trial subject to district conditions, will come in for April and May feeding,

and any surplus that may not be required can be made into ensilage. The seeding specified is per acre.

Japanese millet, 7 lb., and grey spring tares, 45 lb., in 7 in. drills.
Brown barley, 76 lb., and grey spring tares, 60 lb., in 7 in. drills.
Japanese millet, 15 lb., in 7 in. drills.
Sorghum Early Amber Cane, 25 lb., in 28 in. drills.
Maize Red Hogan, 90 lb., with grey spring tares, 75 lb., in 14 in. drills.
Maize Ninety-day or Hickory King, 60 lb., with grey spring tares, 30 lb., in 28 in. drills.
Maize Clarence Wonder or Yellow Dent, 120 lb., in 14 in. drills.
Sorghum Saccharatum, 25 lb., in 28 in. drills.
Sorghum Imphee, 25 lb., in 28 in. drills.

Manure consisting of super, 2 cwt., and bone-meal, 1 cwt., per acre can be mixed with the seed and sown through the drill, or sown separately. With those crops that are drilled at 28 in. apart it will be beneficial to the plants and assist in keeping weeds in check if in the early stages of growth the soil between the drills is kept well stirred by the cultivator.

The varieties of maize mentioned, having plenty of flag, will yield from 25 tons to 45 tons of green forage per acre. The time to use maize is when the cobs are well formed and are becoming glazed. It is necessary that the drills should not be less than 28 in. apart, so as to admit the necessary sunshine to properly develop the crop.

From experience I can fully recommend the varieties of sorghum mentioned —Early Amber Cane, Imphee, and Saccharatum. Sorghum should be sown about the third week in November at a depth of 1½ in. to 2 in. It is necessary to give one stroke with the tine harrows after drilling, and if the land is very dry and of rough surface it should be rolled. After the crop is 4 in. high, and if the weather is favourable, draw the tine harrows across the drills once weekly until the crop gets too high for this to be done. The time to harvest is when the crop is in full bloom; the average yield is from 20 tons to 30 tons per acre.

Of the millets, I have found Japanese, White French, and Pearl to be the best. Sow 15 lb. of seed to the acre, mixed with manure, through the ordinary seed-drill, in drills 7 in. apart. The land should be harrowed across the drills and the crop treated in the same way as sorghum. Harvest when the crop is in full bloom. Do not delay, as the seed soon forms and the crop ripens quickly. Millet can generally be cut with an ordinary reaper-and-binder. The average crop yields from 15 tons to 20 tons per acre.

Japanese millet is also an excellent crop for grazing, especially with dairy cows. The usual plan is to divide the area into breaks with temporary fencing, in order to provide fresh feed according to the size of the herd and area. The herd is allowed to graze on the millet for about two hours morning and evening.

Maize, sorghum, and millet are all susceptible to frost. If a frost should come out of season and turn the crops white in the leaf put the binder in at once and make the material into ensilage.

WINTER FORAGES.

For winter forage crops the land may be ploughed during December, and a thorough cultivation should be given during February and March

with the disk, cultivator, harrows, and roller. The land should be worked until in fine tilth and really good order for sowing the seed. Under ordinary conditions this will be about the first week in April, or as soon as there is sufficient moisture in the land to ensure a good germination.

Among winter forages that have been proved suitable for average conditions, and that are practically free from disease, are the following, the combinations and seedings per acre given being recommended :—

John Brown wheat, 90 lb., and Scotch tares, 60 lb.
Purple-straw Tuscan wheat, 90 lb., and Scotch tares, 60 lb.
Emerald rye-corn, 55 lb., and Marquis wheat, 58 lb.
Emerald rye-corn, 87 lb., and Scotch tares, 60 lb.
Algerian oats, 45 lb., and Emerald rye-corn, 55 lb.
Algerian oats, 45 lb., and Brown barley, 40 lb.
Algerian oats, 45 lb., and Major wheat, 58 lb.
Algerian oats, 55 lb., and Scotch tares, 60 lb.

For manure use from 2 cwt. to 3 cwt. of superphosphate or basic superphosphate per acre.

These forages can be grazed, or they may remain to be cut and carted out to stock as required. Any balance of the crops not required for feeding during the winter months can be utilized for ensilage, chaff, or hay, and will be found equally valuable for feeding to stock during the month of January following, or at any other time when required. An exception must be made in the case of rye-corn, which when approaching maturity becomes too tough for haying purposes.

LUCERNE.

The writer would like to see a lucerne-field established on every suitable farm to the extent of a tenth of its area, for grazing, making hay, or, when the weather is unfavourable for haymaking, for ensilage. Lucerne in either form fed to stock with an abundant supply of mangolds will enable the farmer to tide over many difficulties. This practice should appeal to the small farmer especially. Trussed lucerne hay generally realizes from £7 to £10 a ton in the open market.

Otakeho Lucerne Competition.—This year's lucerne competition at Otakeho, Taranaki, was again judged by Fields Instructors Deem and Glasson. There was a large gathering of farmers, including a number from other parts of the province. The senior class was again won by Mr. E. T. Burke, with a score of 37 points out of a possible 40, as against a score of 35 points last year. It may be noted that this stand, now in its sixth year, was sown down with superphosphate, and was again manured with super in 1919 and 1920. Inoculated soil and lime were also used at its establishment, and it has had subsequent limings. The seed was sown through every coulter of the drill. The Class B competition, for crops sown this season, was won by Mr. S. J. Bennett.

CONTROL OF RED MITE ON FRUIT-TREES.

FURTHER TESTS AT PAPANUI EXPERIMENTAL ORCHARD.

W. K. DALLAS, Orchard Instructor, Christchurch.

A FURTHER series of experiments in red-mite control was carried out this season at the Papanui Experimental Orchard, Christchurch.* The experiments have given very satisfactory results, and the data recorded afford useful information to orchardists.

The trees, though very much freer from red mite at the commencement of the test than they were when last season's experiments began, were not by any means clean. Red-mite eggs were recorded as being very prevalent. The spraying-compounds experimented with were caustic soda, red oil, lime-sulphur with naphthalene, and Calsulph lime-sulphur, used in various formulas and schemes as detailed below. A power sprayer was used throughout at a pressure of 150 lb. to 175 lb., except for the application of Calsulph lime-sulphur, which was applied with a knapsack pump. Arsenate sprays were applied separately, and not within three days of lime-sulphur or other summer spray. The trees in this section received their first arsenate-of-lead spray at calyx period (when about 75 per cent. of the petals had fallen). Advantage was taken in general of dull days to apply sprays. The trees upon which the experiments were conducted were all apple varieties with the exception of nine plum-trees.

TREATMENTS AND RESULTS.

Plot (1). Caustic soda, 1–10, at dormant period, followed by Gargoyle red oil, 1–17, at bud-movement, and subsequently with Gargoyle, 1–60, plus 2½ lb. household soap, at fruit-set, and later two applications of lime-sulphur with naphthalene, 1–100, at an interval of three weeks. Owing to the trees being in blossom when live mites first made their appearance the oil spraying (1–60, plus 2½ lb. soap) had to be delayed until fruit-set. Variety: Sturmer pippin—twenty-one trees.

Before spraying red-mite eggs very prevalent. When examined on 17th August eggs of mite appeared quite healthy after the caustic soda. On 28th September, after Gargoyle (1–17), live mites were slightly in evidence, and a large percentage of the eggs had not hatched. On 6th December, when examined, both live mites and eggs were very hard to find on the trees throughout the whole plot; the trees were practically clean. The fruit was slightly scorched after application of Gargoyle (1–60, plus 2½ lb. soap). This plot of trees is situated close under a tall poplar belt. When examined on 28th December a few live mites and eggs were observed on the foliage towards the centres of the trees. At the final examination, on 28th January, not more than half a dozen live mites and very few eggs were observed. The fruit was russeted to a small extent. The trees were healthy and had made good growth.

Plot (2). Caustic soda (1–10) at dormant, followed by Gargoyle (1–17) at bud-movement, and subsequently with Federation oil, 1–80, plus 2½ lb. soap, at fruit-set; later, two applications of lime-sulphur

* For previous tests see *Journal*, March, 1920.

with naphthalene, 1-100, at an interval of three weeks. Owing to the trees being in blossom when live mites first made their appearance, the oil spraying (1-80, plus 2½ lb. soap) had to be delayed until fruit-set. Variety: Sturmer pippin—twenty trees.

Before spraying red-mite eggs were very prevalent. When examined on 17th August the mite-eggs appeared quite healthy after the caustic soda. On examination on 28th September, after Gargoyle, live mites were slightly in evidence, and, as in plot (1), a large percentage of the eggs had not hatched. When examined again on 6th December, some time after the trees had received Federation oil, both live mites and eggs were scarce. The trees of this plot carried a slightly heavier iniection than plot (1), oil at 1-80 not being so effective as oil at 1-60. Fruit slightly scorched after oil, 1-80, but not so badly as in plot (1). When finally examined on 28th January live mites and eggs were slightly more prevalent than on plot (1). The trees were practically free from red mite. The fruit showed slight russet from the effects of scorching by oil. The trees were healthy and had made good growth.

Plot (3). Caustic soda, 1-10, at dormant, followed by lime-sulphur with naphthalene (1-100) at fruit-set, and subsequently with three applications of lime-sulphur with naphthalene, 1-100, at intervals of about three weeks. Owing to the trees being in blossom when live mites first made their appearance the first lime-sulphur with naphthalene spray had to be delayed until fruit-set. Varieties: Sturmer pippin and others—fifty-eight trees.

Before spraying red-mite eggs were very prevalent. When examined on 14th October live mites and eggs were much in evidence. When examined on 16th November more mites and eggs were noticeable than on plots (1) and (2), though much reduced since last inspection. On 6th December there were a few live mites, and eggs were fairly prevalent. Mites and eggs were noticed particularly on small leaves at the base of leaf-clusters. When again examined on 28th December a few live mites and eggs were observed. These plots were not so free of mites and eggs as plots (1) and (2), but, throughout, the trees were very slightly affected, with the exception of one Sturmer. The trees were healthy and had made good growth.

Plot (4). Gargoyle heated to 120° F. at dormant period, followed by lime-sulphur with naphthalene, 1-100, at open-cluster, and subsequently with three applications of lime-sulphur with naphthalene, 1-100, at intervals of about three weeks. Varieties: Lord Wolseley and New York Pippin—seventeen trees.

Before spraying red-mite eggs were very prevalent. On examination on 17th August it was observed that a large percentage of the eggs had turned white, while the remainder retained their reddish colour. On 14th October only a few live mites and a few eggs were noticed. On 16th November, though a careful search was made, mites were very hard to find. On 6th December a careful examination was again made and mites were not found, and on 28th December mites were nil. At the final examination on 28th January no mites nor eggs were found on these trees. This spraying proved much the more effective for the control of the mite than the sprayings on other plots. The trees were healthy and had made good growth, except four Lord Wolseleys, which were slightly affected with silver-blight.

Plot (5). Lime-sulphur and naphthalene, 1–100, at open-cluster, followed by the same strength of spray at fruit-set, and subsequently with three applications at intervals of about three weeks. Varieties: Rokewood and others—sixteen trees.

Before spraying on 14th October live red mites and eggs were very prevalent. When examined on 7th November live mites and eggs were prevalent. On 6th December many eggs but few live mites were noticed, but more prevalent than on plot (6). On examination on 20th December live mites were few and hard to find. Eggs were noticeable on the first five trees, but were very scarce on the remaining trees in the plot. On examination on 28th January live mites were prevalent on the first five trees of the plot, while on the balance of the trees mites and eggs were scarce. This plot was the worst-infected plot we had. The infection was much reduced as compared with infection present on 14th October. Infection is more difficult to control when dormant sprays are omitted. There was no scorching of fruit or leaves. The trees were healthy and had made good growth.

Plot (6). Gargoyle heated to 120° F., at dormant period, followed by Calsulph lime-sulphur, 1–100, at open-cluster, and subsequently with Calsulph, 1–100, at fruit-set; later two further applications at same strength at an interval of three weeks. Variety: Lord Wolseley —one tree.

Before spraying mite-eggs were prevalent. On examination on 17th August it was observed that a large percentage of the eggs had turned white, while the remainder were healthy-looking. Live mites and eggs were scarce when the tree was examined on 14th October. On 6th December a careful examination was made, when mites and eggs were very scarce and hard to find. On 28th December and again on 28th January, when the final examination was made, mites or eggs were not observed. There had been no scorching of fruit or leaves. The tree was healthy and had made good growth.

Plot (7). Calsulph lime-sulphur, 1–50, at open-cluster, followed by the same strength of compound at fruit-set, and subsequently two more applications at the same strength at an interval of about a month. Variety: Rokewood—one tree.

Before spraying live mites and eggs were in evidence. When examination was made on 27th October live mite was considerably checked. Eggs were in evidence. Another careful examination was made on 6th December, when few live mites and eggs were observed. There was no burning of the leaves or fruit. On 28th December live mites were hard to find. At the final examination on 28th January live mites or eggs were not observed at all. The tree was healthy and had made good growth.

Plot (8). Check tree; no sprays applied. Variety: Lord Wolseley —one tree.

Red-mite eggs were prevalent on 17th August. On 6th December there was a light infection of live mites and eggs. On 28th December the mite infection had increased slightly. At the final examination on 28th January live mites were very prevalent, and had increased since last inspection. This tree then had a heavier infection of red mite and eggs than any other tree in the whole of the experiments, the infection being very conspicuous. Powdery mildew was very much

worse on this tree than on other trees in this section. The tree had made good growth.

CONCLUSIONS.

The results obtained this season confirm those obtained last season—namely, that (*a*) lime-sulphur has apparently no detrimental effect on the hatching-out of red-mite eggs, and (*b*) lime-sulphur is effective against live mites, the infection in all cases being much reduced, compared with what it was when the experiments began. It was noticed that the mites were more readily controlled by lime-sulphur where the trees, during their dormant period, had received an oil spray.

Careful examination of the trees in plots (1) and (2) indicates that Gargoyle, 1–60, plus 2½ lb. soap, is more effective than Federation oil, 1–80, plus 2½ lb. soap. Gargoyle heated to 120° F. (dormant spray) was very effective. It was observed on examination after the heated oil was applied that a large percentage of the red-mite eggs had turned white. Of the seven plots treated, this one is easily the freest from the pest.

Calsulph lime-sulphur has been effective. Caustic soda, 1–10 dormant spray, while being very effective against mussel scale, did not appear to have any effect upon red-mite eggs.

At date of writing the trees are in a very healthy condition and have made good growth. The general condition of the foliage of the check tree is not nearly as fresh-looking as the foliage on the other trees, owing to powdery mildew apple-leaf hopper, and red-mite infection.

Field Competitions.—The Toko and the Mangatoki soft-turnip competitions were judged by Fields Instructors Deem and Glasson during February. The best crop at Toko was 40 tons 11 cwt. per acre, and the average 34 tons 11 cwt.; while the best crop at Mangatoki was 39 tons 7 cwt., and the average 35 tons 12 cwt. per acre.

ASSEMBLING FOR LECTURE ON NATIVE TREES AND SHRUBS: TEACHERS' FARM SCHOOL, RUAKURA, 1921.

WORK FOR THE COMING MONTH.

THE ORCHARD.

FRUIT SHIPMENT PER S.S. "HORORATA."

THE preparation of the shipment of apples for London which was taken aboard the "Hororata" at Wellington on 28th February showed a very marked improvement on anything previously attempted in this line. The outstanding feature, however, was the absence of broken cases and spilled fruit, which were so conspicuous in the sheds and on the wharves during the process of loading last season. This improvement was due almost entirely to the new case-wiring process practised for the first time this year. In many instances the unwired cases of the shipment were of very much better construction than previously, but despite this a certain proportion of breakages occurred. In one instance a line of some 250 cases, the timber and nailing of which was poor, collapsed badly, and the losses would no doubt have been heavy had not the general manager of the Fruitgrowers' Federation, on the advice of the Department, made arrangements to have the whole securely wired before being taken aboard the boat. The value of wiring was so apparent that the Department is making the practice, with respect to bushel cases, one of the conditions under the guarantee in connection with all future shipments.

The variation in the maturity of the fruit was far too great to be considered altogether satisfactory, and this phase of the business must be watched much more closely in the future. Overmaturity was the main complaint levelled at our apples last year. English critics held our export regulations responsible for this, on the assumption that the fruit was held too long on the trees in order to comply with the colour standard. Many growers supported this view. The Department, however, held a different opinion, this being to the effect that the overmaturity complained of was due to unavoidable delays prior to shipment, and in some instances to the packing and direct shipment of overmature varieties, such maturity being in no way associated with the regulations, but wholly due to such causes as the packers' inability to handle the fruit in its proper season. However, in deference to the almost general desire of shippers, the Department slightly relaxed the colour standards for this season, thereby removing what was held to be the primary cause for complaint last year, and also the excuse for shipping overmature fruit in future, a matter which is highly essential, as the success of our export trade depends on the fruit arriving at its destination in at least a sound condition. But regulations alone will scarcely accomplish this unless backed in the right spirit by the grower, resulting in his personal endeavours being towards shipping only fruit in the right condition. If not sufficiently mature it should be held on the tree for a time. If at any time the reverse is likely to apply the fruit should be packed and held in cool storage pending shipment.

Shipping arrangements have been uncertain for some time, owing to the trouble on the waterfront. However, this has now been settled, and the question of future shipments has been taken up with the shipping authorities. The best information available on this point to date is the allotment of space for 15,000 cases on the "Athenic," due to load at Wellington some time between 20th and 25th of this month.

—J. A. Campbell, Assistant Director of the Horticulture Division.

HAWKE'S BAY.

Harvesting the various varieties of apples and pears which attain suitable condition will be the chief work of the coming month. A little care exercised to make selections of fruits that are ready, rather than a general picking, often makes the difference between successful storage or otherwise. Fruits of a ripe nature do not store well, often becoming mushy when stored for the average period of the variety. On the other hand, specimens on which the leaf-green dominates the ground-colour will shrink badly, particularly if subjected to any delay before storage. The type of ground-colour in which the leaf-green has given place to a yellow tinge without being very far advanced has proved the guiding factor which indicates the desirable stage at which to pick. Although when picking it may be impossible to avoid severing from the trees fruits inclined to undermaturity, these fruits can be dealt with more economically if separated from the line picked, as usually they prove to be the unprofitable section of fruit subjected to cool storage, having quite a distinct marketing-period to evenly matured fruits of the same variety, and often becoming culls by being held too long. The question of grading the various qualities has been hitherto more or less neglected when preparing the fruit for cool store, but this being a season of short crops, growers should adopt some more definite proceeding than the old hit-or-miss method in order to enable the crop to be marketed to advantage.

Spraying for the period will consist of an application of arsenate of lead to late-maturing varieties. A sharp lookout should be kept for black-spot — on Dougherty apples especially—and bordeaux, 3–4–50, applied if this disease shows up. Also watch for woolly aphis, and if necessary apply Blackleaf 40, 1–800, to trees in fruit, or oil, 1–60, to trees from which the fruit has been gathered. Get up a good pressure with the pump and aim for a direct hit, with the nozzle as near the tree as possible, so as to take full advantage of the force generated.

Where a cover-crop is required to plough in later this month should prove a suitable time to sow. —*W. H. Rice, Orchard Instructor, Hastings.*

NELSON.

The harvesting of the apple and pear crop will still be the most important work of the month. Some excellent work has been done this season in packing fruit for export. Only one feature requires special mention, and that is the making and storing of the case itself. The present cost of fruit-cases and the need of a really strong case to stand the vicissitudes of an export trade make the subject important. Forty per cent. of the cases are not what they should be, owing to the cutting, making, or storing. Growers are advised to see they get cases cut true and even with a fairly fine saw. Small side pieces with large knots in them are useless. Cases that are well made and closed are a pleasure to handle. They will come up to that description if the maker is careful to select his timber correctly and drive sufficient nails—two in the end of a 5 in., three in a 7 in., and four in an 11 in. piece. The timber being soft and thin, care is often required to avoid overdriving nails and splitting boards. Side boards should not project beyond the end pieces, neither should they be at all short. For the points of nails to project after they are driven is an unpardonable offence. Under present circumstances it is often advisable to specially select cases to be used for the export trade.

For remarks on picking and storing see recent notes. To them perhaps it may be advisable to add another, and that is the need of picking and storing fruit as soon as it is mature and fit. One cannot depend on last year's picking-date or wait until a ship sails; fruit must be picked when it is ready. If it has to be held after that it must be in a suitable store. Some crops are maturing a month earlier than they did last season.

As soon as the crop is gathered most trees could do with a good spray of lime-sulphur and nicotine, to clean up aphis, mite, and fungus troubles. Difficult cases should receive an application of bordeaux, followed by oil. Give a second application where necessary; it is a most suitable time for effective work.

Where a cover-crop is needed but has not yet been sown, oats and vetches may be broadcasted or drilled in during the month. The crop should make excellent growth before the spring ploughing commences.

—*W. C. Hyde, Orchard Instructor, Nelson.*

MOTUEKA.

The principal work for the coming month will be the harvesting and storing of the main crops of the later varieties of apples. In connection with this, the advice given in the March number of the *Journal* last year should be borne in

mind. Only good-quality fruit should be selected for storing. Accumulating storage charges on inferior fruit will not be found a payable proposition.

Spraying measures will consist chiefly of the application of arsenate of lead to prevent late attacks of leaf-roller caterpillar. Much damage is likely to be done to fruit by these insects after storage unless preventive measures are adopted. Lime-sulphur, 1 120, should also be applied to prevent late attacks of black-spot, especially on fruit that is intended for storage, so as to prevent development of the spores after the fruit is placed in the store.

All fruit infected by codlin-moth should be kept picked and be destroyed. Infected fruit should not be left on the trees, or lying about, either on the ground or in cases. It should be remembered that every matured larva that is allowed to get away is responsible for a large increase next season, and every effort should be made to prevent this happening.

—W. T. Goodwin, Orchard Instructor, Motueka.

CANTERBURY.

Pests and diseases of pip-fruits: Trees infested with woolly aphis should be sprayed with Blackleaf 40, 1–800. After the fruit has been picked good results can also be obtained by using red oil, 1–60. If leaf-roller caterpillar is in evidence the trees should be resprayed with arsenate of lead, paste 3 lb. or powder 1½ lb. to 100 gallons. To prevent a late infection of black-spot growers in localities where fruit is subject to spot would be wise to apply a further spraying of lime-sulphur, 1–120.

Pests and diseases of stone-fruits: Growers of stone-fruits should gather all mummified fruits, and leaves showing signs of peach-curl infection, and destroy them by fire. Stone-fruit trees should receive a spraying of either lime-sulphur, 1–125, or bordeaux, 3–4–50, before they commence to shed their leaves.

Spraying: Orchardists should thoroughly investigate the results obtained during the past season from the spraying-compounds used and the methods employed in their application. Progressive growers not only do this, but go further and determine the factors that contributed to success or to unsatisfactory results, as the case may be. Where unsatisfactory results are obtained something is wrong. Factors which contribute to success are a knowledge of the life-history of diseases; the spray to prevent disease becoming established; the use of the correct compounds; correct mixing of compounds; and the thorough application of sprays at the correct times.

Harvesting the crop: The work of picking, packing, and marketing apples and pears will continue this month; also the storing of the late varieties of apples and pears in cool storage, or fruit-storage houses. The greatest care must be exercised in handling fruit for storage purposes, because damaged fruit will not keep in storage, and, moreover, such fruit is a financial loss.

Green-manuring: If this crop is not in, it should be attended to with as little delay as possible.

Cultivation: In orchards where cultivation has been regularly attended to it would be wise to give the land a complete rest until the winter ploughing, when the weeds which have grown will be ploughed in before they seed. Growers intending to plant out additional land in fruit-trees should plough it as soon as possible.

—W. K. Dallas, Orchard Instructor, Christchurch.

POULTRY-KEEPING.

F. C. BROWN, Chief Poultry Instructor.

TUBERCULOSIS.

THIS is the time of the year when a sharp lookout should be kept on the flock in order to observe any bird that shows signs of being affected with tuberculosis. One-year-old and two-year-old hens are most apt to become affected. The exhaustive laying-period which they have passed through has been a heavy drain on their system, so that once the disease is contracted they soon show signs indicating that it is present.

The symptoms generally shown are, firstly, a gradual wasting, particularly around the breast-bone, the latter standing out as a sharp ridge. It will also be observed that the bird has a listless appearance and seldom mixes with other members of the flock. As the disease develops the wings and tail droop, and the comb and wattles become pale and flaccid. During the latter stages of the disease a yellow and in some cases a mixed green coloured diarrhœa sets in. Another common symptom at this stage is a limp, generally on the right leg. This disease is sometimes known as "going light," for the reason that in advanced cases the bird is practically devoid of flesh. Another term for it is "spotty liver," because where there are similar symptoms to those described in nearly every case for which a *post mortem* examination is made a spotted appearance of the liver will be noticed.

The remedy for the disease is prevention. Once it makes its appearance the first step is to kill and burn all birds showing signs of infection, while even suspicious cases should be isolated without delay. Where possible, the healthy-looking birds in the affected pen should at once be moved to fresh quarters which have been well cleaned and disinfected. The houses where the infected birds have been kept should be thoroughly cleaned, disinfected, and if possible left vacant for some considerable time. The runs also should be turned up, heavily limed, sown down, and given a good rest. Judging from my observations, tuberculosis in poultry is certainly on the increase, and the fact cannot be emphasized too strongly that prevention is the one and only thing to aim at in keeping it at bay. The great essential is to see that the birds are bred with the necessary constitution, and are fed and managed in such a way that they will have the power to resist infection should they come in contact with it. Too much importance cannot be placed upon the value of plenty of fresh air in houses, but without draughts. Strict attention to cleanliness, and never allowing the runs to become poultry-sick for the want of being dug up, sown down, and rested are also matters that must not be overlooked. The disease is most common where the birds are housed in dirty, ill-ventilated quarters, and where the runs have got into a tainted condition. Where possible double runs should be provided for every fowlhouse, in order that they may be alternately spelled, cropped, and allowed to sweeten.

Reference has been made to one-year-old and two-year-old birds being most susceptible to tuberculosis, but this is not to say that younger birds are immune from it. It may be true that in years gone by it was rare to see a young bird affected, but this is not the case now. As an instance, cases have recently come under my notice of young pullets from four to five months old being badly affected.

Tuberculosis is undoubtedly the most serious disease the poultryman has to fear in this country, as besides its fatal nature it can be so easily conveyed from one bird to another. As before mentioned, the disease is on the increase, and in my opinion this is chiefly due to the craze in breeding for an increased egg-production generation after generation, and ignoring constitutional vigour, thereby making the bird susceptible to the disease should it come in contact with the infection. Breeding for high egg-records is all right in its way, but of what avail is it if the bird's vigour is not preserved in the process and the flock is apt to be swept off by this and other diseases? A principle generally realized in breeding is that any one character can only be improved at the expense of another, so that if everything is sacrificed to high egg-records something must suffer. The warning is here, and if not heeded tuberculosis and other diseases must increase as a consequence.

SUBSTITUTES FOR WHEAT.

Owing to the difficulty and in many cases inability to secure wheat, poultrymen have been compelled to experiment with substitutes for this favoured grain. This course has in many cases reduced the cost of production and returned an increased output of eggs. As an instance, a successful poultry-farmer informed me the other day that for years he used nothing else but wheat as a grain food for his flock, but of late, owing to the limited amount of wheat available, and in order to make it last out, he had adopted the system recommended in the Department's poultry pamphlet of mixing oats and maize with it, with most gratifying results. This grain ration not only increased the egg-yield, but in addition the birds maintained a more healthy and vigorous condition than ever before. Moreover, he declared that his young stock thrived better on this ration, and promise to attain a more desirable size and healthy development than during the whole of his past experience.

STARTING POULTRY-FARMING.

I have received many inquiries of late as to the amount of capital required to start a poultry-farm sufficiently large to provide a livelihood. The inquiries often go further and ask the amount of money that would be made the first year and the second year, and at what period would from £6 to £7 a week be assured. Such questions are not capable of being answered with any degree of satisfaction. It is to be feared that the majority of those who inquire as to the money to be made from a big commercial poultry undertaking, based on pencil-and-paper calculations, know practically nothing about it, and fail to realize that success or otherwise chiefly depends on the man in charge of the venture. Some men could establish a payable business on half the capital others would require, while others, again, would sink a fortune in the venture and then fail in the objective. There is no royal road to making a success of a large poultry plant. It is a business which should be approached as a business, and learnt like any other profession, trade, or calling. Even then much will depend on the personal equipment of the one taking it up. It must be remembered that to make an independent living from the business land and stock must be purchased, a dwellinghouse, poultry-houses, runs, &c., built, and other equipment provided. This, especially in view of the present high cost of building-material, &c., involves a heavy expenditure. In addition, maintenance must be provided for the poultry-keeper and any family for at least one year. Obviously, it would be unwise for any one to sink the required capital in such a venture without having a thorough grasp of the essentials of the industry. My advice to the novice who contemplates poultry-keeping in a big way is to commence with a small number of birds, and develop the plant as experience warrants it; or, as an alternative, serve an apprenticeship under a thorough, practical man. Like many other things, it is an easy matter to make poultry-farming pay on paper. Theory is all very well in its place, but it must go hand-in-hand with experience.

THE APIARY.

G. V. WESTBROOKE, Apiary Instructor.

WINTER STORES.

When removing the honey from the hives for the final extracting the matter of winter stores should not be lost sight of. It is better policy to leave the bees with rather more honey than they require than to have to start feeding them before spring. It is generally considered that 40 lb. is sufficient to carry an average colony through until the spring flowers are providing nectar. Do not be content with guessing the amount of honey left in the hives, but carefully examine each one before closing it down for the season. From now on great care must be taken when manipulating the hives not to leave them open too long, as there is danger of starting the bees robbing. While the bees are gathering honey freely it is quite safe to leave the frames exposed when handling them, but as soon as the supply from natural sources begins to diminish the bees will take every opportunity of stealing. This causes great excitement in the apiary and makes the bees very vicious and difficult to control.

FOUL-BROOD.

The disease *Bacillus larvae*, better known as foul-brood, is the worst pest that New Zealand beekeepers have to contend with, causing great loss annually in honey, bees, and money. It should therefore be the aim of the amateur as well as the commercial beekeeper to take every precaution for checking the spread of this disease. Whenever found it should be dealt with at once, either by destroying the hive-contents by fire, or, if conditions are favourable for treating the infected colonies, by having this carried out immediately. Foul-brood has so often been dealt with in these columns, and in the leaflets published by this Department, that it is not necessary to go fully into the method of treatment again. It may, however, be of interest and act as a warning to the beginner to

quote from an article recently published by Professor G. F. White, of the Bureau of Entomology, U.S. Department of Agriculture, who writes :—

"Since *Bacillus larvae* is the inciting cause of American foul-brood, naturally this disease can only occur when the germ is present and alive. The task of preventing the disease by keeping the living germ away from the apiary is not an easy one, although much can be done in this direction. The length of time the germ will live under various environments is therefore of first importance. Some idea relative to this point may be gained from experimental observations which have been made. Scales containing the spores of American foul-brood were collected in 1907 and kept in the laboratory until September, 1916. Each succeeding year during this period of more than nine years tests were made, using some of this scale material, and in every instance the spores were found to be alive. It was found also that they were as resistant to heat, and, by the inoculation of the colonies, they were found to be as virulent at the end of this period as at any previous time. It has not yet been determined how long the spores will remain alive in the dry scales, but it is quite probable that they will live much longer than nine years. When the spores from the scale material were suspended in water and heated to boiling-point (212° F.) they were all killed in eleven minutes. A half-hour or more may be necessary when they are in honey. By employing a higher temperature the period of heating may be diminished. A water suspension of the scales was poured in a thin layer on glass plates and allowed to dry. These films were exposed to the direct rays of the sun. The spores were found to remain alive for from twenty-eight to forty-one hours. They remained alive from four to six weeks when they were suspended in honey and exposed to the sun. The spores added to honey and kept away from the direct sunlight were found to be alive and virulent after one year. It is very likely they are capable of remaining so for a very much longer period in such an environment. In the presence of fermentation the spores were found to be alive and virulent at the end of seven weeks, and it is quite likely they would have remained so for a very much longer period. In a 5-per-cent. carbolic-acid solution the spores of American foul-brood remained alive for months; in a 1–1,000 mercuric chloride solution, for days; and in a 10-per-cent. formalin solution for hours. From these facts it will be observed that the spores of foul-brood are able to live over long periods in nature, and that the beekeeper cannot wait until they die a natural death if he wishes to make sure that they are dead, but must take active measures to destroy them. For practical purposes chemical disinfectants are not suitable. Heat would seem to be the most practical agent. Burning or scorching will, of course, kill the spores, and the boiling of water or honey containing them will cause their destruction. In practical apiculture a somewhat longer period should be adopted in using chemical disinfectants to kill the spores, or in boiling to destroy them, than is indicated as being necessary in the experiments that have been cited here."

THE GARDEN.

W. H. TAYLOR, Horticulturist.

VEGETABLE-CULTURE.

One of the matters requiring attention at this time is the raising of cabbage, cauliflower, and lettuce for the spring crop. Fresh vegetables are eagerly looked for in spring; in private gardens they are appreciated, and market-garden crops usually command a fair price. The time to sow the seeds and the manner of raising them vary in different places. In the colder districts of the South it is necessary to sow in February. March is the time for the North Island and some parts of the South Island, and sowing should not be carried out too early in the month. It has been found that if the plants are raised too early a large proportion will bolt to flower instead of heading properly. The last week in March is the time generally approved for sowing. In places that are warm and sheltered and not subject to winter frosts the plants can be raised in the open ground. In other places cabbages can be so raised, but not cauliflowers, which latter are more tender. In some places both may be raised in the open, but progress is too slow.

The plants should be ready to set out in June or early in July, and where they cannot be got ready by entirely open-air culture frames should be used. Shallow frames are more suitable than greenhouses. The seed is sown in prepared beds, not in boxes, and every fine day the lights should be taken off, giving the plants full exposure, except for the protection afforded by the sides of the frame. This is an important part of their culture; it keeps the plants firm and hardy, and prevents their being drawn up. Frame growing is useful in another way. In some places the diamond-backed moth is troublesome, even so late in the season, and when the young plants are in frames they can be protected by fumigating and by spraying well with tar-water, and so saved, when it might be impossible to do so in the open air. For this reason frames are useful in the warmer districts, though not required for any other reason. The cabbage grown should be an early variety, such as Ellam's Early or Flower of the Spring; while for cauliflowers Snowball, Early Paris, or Early London are suitable. It is best, however, to sow two kinds of cauliflower, the other being of the Autumn Giant type. These are large kinds, and take so much longer to grow that they come in when the early sort is finished. Lettuces will grow in the open in most parts, but shallow frames are an advantage in many places. Turnips for winter supply should now be sown as directed last month.

Onions: These are now ready for harvesting; in many places they are already off the ground. The bulbs should be left lying on the ground for a few hours, or even a few days in places not too hot, until they are dry. They should then be placed on the floor of an airy shed, where they can remain until the tops are quite sere. The tops and loose skin should then be taken off and the bulbs stored in a dry, well-ventilated place. It is usual to sow onion-seed towards the end of March or early in April, but the purpose for which they are required is not always the same. Any one wishing to grow bulbs of large size must sow at the time mentioned; it cannot be satisfactorily done by sowing in spring. A large variety, such as Ailsa Craig, is sown in a temporary bed, the plants being finally planted out as early in spring as possible. It is not advisable to sow where they are to grow; transplanting appears to be necessary to counteract a tendency they have to bolt to seed when this is not done. In some places mildew is a source of trouble, making the proper finishing of spring-sown crops very uncertain. In such places autumn sowing is extended to the smaller keeping kinds. Onion-mildew usually appears when a spring-sown crop is nearly full grown, and prevents proper ripening. Autumn-sown bulbs ripen earlier and mildew rarely affects them. Bulbs from an autumn-sown crop do not keep so long as do properly ripened bulbs from a spring crop, and for this reason spring sowing is to be preferred wherever it succeeds. In places where success is doubtful autumn sowing is the proper thing, as it also is in places subject to severe drought in summer, enabling the growing of good bulbs not to be had by spring sowing, and in such places a fairly good keeping-quality is secured. In the case of keeping varieties it is best to transplant, but this is not so important as it is with the large kinds. Bulbs from a crop not transplanted are likely to average larger than those transplanted, and both should be larger than bulbs from a spring-sown crop. The condition of the soil should be the deciding factor as to which course to pursue. If the soil is heavy it may get into bad condition during winter, or the soil may become covered with weeds. If either condition is likely to occur the seeds should be sown on a small area, and be transplanted in spring to ground kept cultivated for the purpose.

In all the warmer districts spinach and silver-beet may still be sown; also carrots of the Early Horn type, which come quickly into use.

SMALL-FRUITS.

Strawberries.—In places where Autumn planting is the rule the soil should now be in a state of preparation, and must be kept well cultivated until planting is done. The fertilizers that are to be given, with the exception of nitrate of soda, should be applied when the last harrowing is done. If the soil is of a light porous character pass a roller over the plot after planting. The rolling will consolidate the soil and give the plants a good start. Rolling will not injure the plants. Of course, rolling would not answer for heavy soil, particularly if composed of clay. Where spring planting is done the runners should be lifted now and planted in temporary beds. The plants may be placed 3 in. or 4 in. apart in rows just wide enough to allow of hoeing to keep weeds down. In this position the plants will make fresh roots, and will give a much heavier first crop than plants not so treated. A quite general mistake is to take too many young plants or runners from each old plant. This

means that many of them are late growths, not having matured crowns, and these have to make new crowns before they will bear any fruit worth mentioning. I have witnessed the planting in spring of young plants of very small size and with very little root. Such planting is waste of time and money, and could be avoided by paying a little attention to the runners in early autumn.

Loganberries.—The long rods made this season will bear fruit next year. Although the rod will bear fruit for two seasons, the usual practice is to keep them only one season. This is the best plan when they are trained to wire supports, which is the only feasible method in plantations of any extent. In such cases the old rods should be cut away as soon as fruiting is over, so that the young rods may be well exposed to light and air, which enables them to ripen and plump up the buds. In the case of a plant or two trained to a fence or building, as many are, it is best to keep the rods two seasons. The rods should be trained in systematic order so as to properly cover the allotted space, and need not be more than 10 in. or 12 in. apart. During the first year of bearing young rods that appear should be suppressed. Fruit is borne on short sprays or shoots that spring from the buds on the rod. During winter these sprays should be cut back to one or two buds at their base, and from these buds sprays of fruit will spring next season, most likely producing a heavier crop than that of the first season. The rods will bear fruit twice only; therefore during the second year young rods should be allowed to grow. After fruiting the old rods should be cut out and the young ones laid in their place. When in a proper position as regards sunshine, and provided with good soil, the loganberry trained in this way will produce more fruit in a given space than will any other known fruit. They are worthy of careful attention.

Cape Gooseberries.—These plants have a life of two or three years. As far as I am aware, plants raised in spring will live to produce three crops, but if raised in autumn they will bear only two crops. In any case, I am quite satisfied the plants should be raised in autumn, as they produce a much heavier crop the first year than do spring-raised plants. Seeds should be sown in April, the plants pricked off when ready, and kept in boxes until danger from frost is past. They are then strong, well-hardened plants when set out, and probably they would do well in some places where difficulty is being experienced with spring-raised plants. In some Northern districts Cape-gooseberry plants are badly attacked by a rust disease. Theoretically, this disease should be controlled by a bordeaux or lime-sulphur spray; the hairy nature of the leaves, however, renders it very difficult to spray effectually, and if the disease has a firm hold before spraying is commenced it will be impossible to stop it. The only chance is to spray before the disease appears.

STUD SOUTHDOWNS AT RUAKURA.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

OATS FOR SHEEP.

"INQUIRER," Enfield :—

As oats are likely to be cheap this season, can you give me any information as to the feeding of oats to breeding-ewes and fattening sheep and lambs? Would oatsheaf chaff be suitable, or would the oats be better crushed and mixed with chaff? What allowance per sheep should be made, and how should it be fed?

The Live-stock Division :—

It is not advisable to feed oats to breeding-ewes. Ewes coming to the lambing in a fat plethoric condition are liable to no end of trouble. Oatsheaf chaff is a suitable feed for fattening sheep and lambs. The chaff should be cut about three times the ordinary length, so as to ensure mastication. A mixture of crushed oats and straw chaff is equally as good, but the former method involves less labour. The daily allowance per head ranges from ½ lb. to 1½ lb.

SAVING TOMATO-SEED.

"AMATEUR," Roslyn :—

Will you please explain the method of saving tomato-seed?

The Horticulture Division :—

There are several ways of saving tomato-seed when a quantity is required. Some allow the fruits to decay and partially dry up, the seeds being then easily taken out and washed. A better plan is to take good specimens when partly ripe, keep them till perfectly ripe, and then cut the fruits open and squeeze the seeds into a vessel. Leave them standing a few days to ferment; then add water and thoroughly wash the seeds; pour off the water, add fresh, wash again, and repeat until the seeds are clean. Spread the seeds thinly on paper or canvas and dry in the sun. When half dry rub between the hands to separate the seed, and when thoroughly dry store in a dry place. Some prefer to keep the seed in screw-top bottles or jars, but it appears to keep quite well in paper bags, provided they are kept in a dry place. The fruits for seed should be taken from the first or middle bunches, not from the last of the crop.

PENNYROYAL AND LIVE-STOCK.

S. G. M., Wanganui :—

Will you kindly tell me if pennyroyal is in any way injurious to cows, horses, or pigs?

The Live-stock Division :—

A large amount of pennyroyal must be eaten by stock throughout New Zealand every year, and when an abortion outbreak has occurred where pennyroyal is present many farmers have no doubt blamed it, though the outbreak has most probably been due to the organism of contagious abortion. There has been no direct evidence produced to implicate pennyroyal in the loss of stock.

APPLICATION OF LIME.

B. B., Papanui :—

I am applying agricultural lime to my orchard and garden, and should like to be advised as to whether it should be ploughed or dug in at once or left lying on the surface for the weather to work in.

The Horticulture Division :—

Although no harm results from leaving unburnt lime on the surface for a time, yet it does very little good until acted on by the soil-water. For this reason it should be worked in at once. Washing in by rain is a very slow process. When burnt lime is used it should be at once thoroughly mixed with the soil, as if it is left on the surface it sets in cakes and is then troublesome to break up. Burnt lime should not be applied in the quick state. It should be either slaked with water, or, which is far better, be left to slake by air until it is reduced to a powder, in which state it is again carbonate of lime, the same as before being burnt, but in a finely divided state.

BLINDNESS IN SHEEP.

"AVONDALE," Lismore :—

I have noticed on several of my ewes and lambs a mattery discharge coming from the eyes. About three of the ewes have become blind, a cataract seeming to have formed over the eyes. Can you assign any cause for this, and advise a cure ?

The Live-stock Division :—

From the description given the inflammatory condition seems to be conjunctivitis, or inflammation of the fine membrane of the eye, which has ultimately formed ulcers on the eyeball, thereby causing blindness. Inflammation of the eyes may be caused by cold, high winds, or dust, or by injuries caused by grass-seed, chaff, or other foreign bodies gaining entrance to the eye. The treatment recommended is to thoroughly examine the eyes affected. If any foreign material is present it must be removed and a wash composed of boracic acid, 15 grains, and water, 1 oz., applied to the eye. A few drops dropped on to the eyeball daily for three or four days is generally sufficient to abate the inflammation. Where the eye has become ulcerated—that is, where the inflammation has been severe and the covering of the eye injured—the following lotion gives good results : Sulphate of zinc, 4½ grains, water, 1 oz. A few drops should be dropped into the affected eye once daily for three or four days.

FERTILIZATION OF RED CLOVER BY HONEY-BEES.

C. N. WILLIAMS, Ohoka :—

Can you inform me whether honey-bees can fertilize red clover or cow-grass seed ? I have this season seen hundreds of honey-bees at work on red clover, mostly Italians, but also some black bees.

The Horticulture Division :—

It is now an established fact that the honey-bees of both Black and Italian races do fertilize these clovers. The activity of the bees is much more apparent after the first cut, but this may be due to the probability, as far as this Dominion is concerned, of the plants not yielding nectar in quantities, owing to low temperature, during the early part of the summer.

CONTROL OF GREEN-FLY IN THE GARDEN.

C. BURRY, Auckland :—

Will you kindly advise me as to the most effective means of preventing green-fly from attacking vegetables ? At present they are destroying nearly everything in the garden. I have tried arsenate of lead and also kerosene and hot water.

The Horticulture Division :—

Green-fly, the grey cabbage-aphis, and the various plant-lice that affect vegetables are quite easily controlled by spraying with the nicotine specific Blackleaf 40, 1 in 800 (which means 1 pint in 100 gallons of water), to which should be added 3 lb. or 4 lb. of softsoap; or with XL All fluid, 1 in 30. The latter being quite ready for use, merely having to be mixed with cold water, is best for use in small cultivations. Arsenate of lead is of very little use, a contact spray being required. Kerosene is a good remedy, but must be emulsified, as it will not otherwise mix with water. Kerosene, even when emulsified, is liable to injure the plants, which the specifics advised do not do. Apply in a fine misty spray.

APPLES FOR COWS AND PIGS.

"FARMER," Silverdale :—

Could you kindly inform me if raw apples are good for milking-cows or pigs?

The Live-stock Division :—

Apples, fed reasonably in conjunction with other foodstuffs, are beneficial as an item in the daily rations of both cows and pigs. When fed to cows they should be crushed or broken, otherwise they are liable to cause choking. It is not advisable to feed apples in a decayed condition to any animals.

ERADICATING PERIWINKLE.

S. HOLDSWORTH, Mount Pleasant, Masterton :—

Can you inform me of an effective method of killing a patch of periwinkle? Altogether I have nearly ¼ acre, and it is spreading rapidly.

The Live-stock Division (Noxious Weeds Inspection) :—

Periwinkle is somewhat hard to eradicate, and the best method to adopt is grubbing it up and burning the refuse, and, if it can be managed afterwards, cultivating and cropping the land for a year or two. If, however, the land is unsuited for cultivation, the following treatment is advised: First cut off all the growth as well as you are able and burn the refuse; then give the roots a good spraying with the following preparation: 3 lb. arsenic, 2 lb. caustic soda. Boil in 3 gallons of water till thoroughly dissolved, then add 10 gallons of water to each gallon of the mixture. Spray the roots heavily, and repeat should there be any new growth showing. As this mixture is highly poisonous, stock require to be kept off the treated area for three weeks at least. The mixture is best made in kerosene or petrol tins, as these can afterwards be destroyed.

TREATMENT OF GREASY HEEL.

"SUBSCRIBER," Elsthorpe :—

I have a draught mare that has a chronic form of greasy heel, all the legs being affected. Three have benefited by treatment, but one fore foot has developed deep cracks round the top of the hoof, especially at the heel. The foot swells around the coronet, is very painful for a day of two, and then cracks, the heel being the worst part. I have bathed with hot water, and also poulticed, but as soon as one crack heals the foot swells and breaks again, there being a white discharge oozing from the heel. Will you kindly advise treatment?

The Live-stock Division :—

You are recommended to poultice the heel which does not respond to your treatment, and the following morning wash with hard soap and dry thoroughly. Then apply on a piece of wool a sufficient quantity of the following lotion: Formalin, 1½ oz., water to 1 pint. Apply every day, washing the parts only when necessary. Give ½ oz. doses of nitrate of potash daily in feed during treatment.

NOTICE.—A letter addressed to John Thompson, Reefton, regarding an inquiry, has been returned by the Post Office as "unclaimed."

WHEAT PRICES.

STATEMENT BY MINISTER OF AGRICULTURE.

THE following statement was made by the Hon. W. Nosworthy, Minister of Agriculture, on 14th March :—

It will be remembered that at the end of February of last year I met representative wheat-growers in conference at Christchurch, and discussed fully with them the question of the production within New Zealand of sufficient wheat for our own domestic requirements, thereby doing away with the necessity of relying on importation to provide us with our staple food. I need not stress the dangers that we run if we have to rely on importations of either wheat or flour to feed our people, as it is fairly obvious that our supplies are liable to sudden interruptions if anything interferes with the smooth running of our shipping. During recent years shipping communication with our nearest source of supply—Australia—has been interrupted for long periods, and during these interruptions, had we not had within our own borders sufficient wheat and flour, the people of New Zealand would have been reduced to the verge of starvation.

At the date I have mentioned—February, 1920—the Government Statistician had estimated that there was under crop only 170,000 acres of wheat, whereas if we are to be independent of outside supplies we must crop approximately from 250,000 acres to 275,000 acres—that is, assuming the yield to be normal. With a knowledge of the seriousness of the position that faced New Zealand, I offered on behalf of the Government a minimum guarantee of 7s. 3d., 7s. 6d., and 7s. 9d. per bushel, f.o.b. southern ports, for good milling-wheat of the season 1920–21, with six increments in price of ¾d. per month from the 1st May, and, further, that market rates in excess of the minimum would be paid if the value of wheat rose when we had actually to take over and harvest the crop. During last year the price of wheat rose steadily in the world's markets till May, when wheat was worth approximately 18s. per bushel f.o.b. New York, allowing for the depreciation in the exchange. From May until October there was a steady fall in the price of wheat. In the months of October and December there were sensational drops, and the decline still continues. For instance, in October Australian wheat was quoted in London at 121s. per quarter, whereas to-day's price is 72s. per quarter—a drop of 6s. 1½d. per bushel.

In July of last year I met representatives of the Wheat Trade Committee for the purpose of determining what interpretation should be given in certain circumstances to the Government's guarantee. It was necessary, for instance, to determine on what basis market rates would be fixed. It was anticipated at that time that Australia, if she had a surplus, would be back to normal trading conditions, and on this assumption the following basis of interpretation was agreed upon :—

(*a*.) In the event of New Zealand requiring to import, an adjustment will be made on the basis of the price at which milling-wheat can be purchased in February, 1921, and landed ex wharf, having regard to quality and to the necessary adjustment between North Island and South Island. (*b*.) In the event of New Zealand growing sufficient for its requirements, an adjustment will be made on the basis of f.o.b. Australian value, provided Australia has any exportable surplus, but in any case the purchase price will not be less than the minimum for the respective varieties with the monthly increment.

This raises two important questions: (1) Will we require during the year to import wheat, or, alternatively, have we reasonable grounds for supposing that the present crop will suffice for our requirements? and (2) what is the world market rate for wheat in February, 1921?

I will deal with the former question. As a result of the Government's guarantee the area under wheat rose from 140,000 acres to 210,000 acres. The Wheat Control Office figures show that last year the average yield was 35 bushels per acre. If this yield could be relied on, the total crop this year would amount to 7,350,000 bushels. It would be unsafe, however, to anticipate that we will this year get the same big, phenomenal yield as occurred last year. From all reports coming to hand at present it is clear that the yield per acre this year

will be big. The average of the last ten years has been approximately 29 bushels per acre. Assuming the average this year to be 30 bushels per acre, the total yield will be between six million and six and a half million bushels. The requirements of New Zealand for all purposes are difficult to estimate. For the year just closed the mills gristed approximately 5,600,000 bushels. The seed requirements are probably 500,000 bushels, while last year we got through with another 150,000 bushels for all purposes, including the requirements of the poultry industry. Hence last year we could say that our requirements were approximately six and a quarter million bushels. It is clear therefore that if nothing untoward occurs to upset the estimates in regard to this harvest, New Zealand could, if necessary, get through this year on its domestic production of wheat.

The next question to determine is the market value of wheat during the month of February, as, according to the Government's promise, we were to pay the farmers for this crop that rate if it could be determined. During February the price of Australian wheat in London fell as follows :—

	Per Quarter.			Per Bushel.	
	s.	d.		s.	d.
February 2	97	6	equalling	12	2¼
,, 4	92	6	,,	11	6¾
,, 8	75	0	,,	9	4½
,, 12	75	0	,,	9	4½
,, 16	72	0	,,	9	0
,, 26	72	0	,,	9	0

To arrive at the equivalent value f.o.b. Australia, allowance must be made for freight and insurance. Freight has shown a considerable drop. In December, 1920, and January–February, freight quotations have receded from 160s. per ton to 75s. per ton. I therefore give another table, showing the f.o.b. value of Australian wheat after allowing for freight as quoted in Australia on the same date as wheat-price quotations in London. This will give the price for wheat in Australia at above its real value, as allowance must be made for the time it takes wheat to reach the London market :—

1921.	C.i.f. London.		Less Freight and Charges.		F.o.b. Australia.	
	s.	d.	s.	d.	s.	d.
February 2	12	2¼	3	5¼	8	9
,, 4	11	6¾	2	11¼	8	7½
,, 12	9	4½	2	1	7	3½
,, 16	9	0	2	1	6	11
,, 26	9	0	2	1	6	11

To arrive at the actual worth of wheat in Australia to-day the price in London to-day should be taken less the cost of transportation of the wheat now arriving in London. Thus to-day's price in London for all Australian wheat now arriving (which was shipped, say, six weeks ago) is 9s. per bushel; the freight at which it was carried six weeks ago was 135s. per ton, equivalent to 3s. 7½d. per bushel; other charges, 1d.; making the total charges 3s. 8½d. per bushel. Therefore Australia will receive for this wheat a return of 5s. 3½d.

The Australian Wheat Board in December fixed the price of wheat for domestic consumption and for export at 9s. per bushel, and prohibited the export of wheat from Australia, except through the Australian Wheat Board. The Government, of course, were quite within their powers in fixing the price for domestic consumption at whatever figure they liked, but the price for export depends entirely upon what buyers in various parts of the world are prepared to give, and the London market still rules the world price of wheat. For export, therefore, they could just as reasonably have fixed the price at 20s. per bushel, but that would not mean that they could get this price from buyers, nor are they getting 9s. from export buyers.

I have shown that for wheat shipped in January at the high rate for freight then prevailing they are realizing to-day in London the equivalent of 5s. 3½d. f.o.b. Australia. I do not say that this is the value of wheat f.o.b. Australia to-day, as freights in the meantime have considerably fallen. To-day for full cargoes freight as low as 65s. per ton has been quoted. Assuming the price of wheat falls no lower in London, but remains at 9s. per bushel, then when this wheat paying a freight of 65s. per ton reaches the London market it will return Australia the equivalent of 7s. 3d. per bushel f.o.b. In fact, our advices from Sydney state that this figure, and not the Wheat Board's quotation, is the real value of wheat

f.o.b. Australia. Furthermore, the Minister of Agriculture in Sydney, at a deputation of millers on 27th February, admitted having sold at 8s. f.o.b. Australia, and Australian newspapers of the same date reported sales at the equivalent of 8s. per bushel f.o.b.

In settling the prices for New Zealand I adopted the admitted price of 8s. per bushel f.o.b. Australia as the basis of calculations for this year's crop. To import wheat from Australia to New Zealand costs approximately 10d. per bushel; this would make wheat cost, ex ship's slings Auckland, 8s. 10d. The equivalent price in the South Island of wheat selling for 8s. 10d. in Auckland is approximately 8s., and this is the price I have recommended the Government to fix for our best grade of wheat, with the proportionate reductions agreed upon for varieties less in quality. I claim, therefore, that the prices of New Zealand wheat fixed by the Government fulfil both in the letter and in the spirit the terms of our guarantee. In addition the Government has guaranteed a minimum price for next year of 5s. 6d., 5s. 9d., and 6s. 3d., with the same monthly increments.

The following are the maximum prices to be paid for the current season's wheat crop, as gazetted on 14th March: 7s. 6d. per bushel, f.o.b. southern ports, for Tuscan and similar varieties, 7s. 9d. for Hunters, and 8s. for Pearl, with increments of ¾d. per month, commencing on 1st May. The Minister has announced that the Government has agreed to guarantee the following minimum prices for wheat of the 1921–22 season: 5s. 6d. per bushel, f.o.b. southern ports, for Tuscan and similar varieties, 5s. 9d. for Hunters, and 6s. 3d. for Pearl, with increments the same as this year.

NAURU/OCEAN ISLAND PHOSPHATE.

TERMS AND CONDITIONS FOR SHIPMENTS.

THE preliminary negotiations have been completed, and the following terms and conditions approved for all shipments of phosphate rock from Nauru and Ocean Islands up to and including 30th June, 1921:—

The price of the phosphate delivered at Auckland, Wellington, Lyttelton and [or] Port Chalmers, Port Chalmers and [or] Bluff, will be £4 5s. per ton of 2,240 lb., covering the cost of freight and insurance (f.p.a.) to port of discharge. Any insurance against war or other special risks shall be paid by the buyers. This price applies only to cargoes of from about 4,000 to 6,000 tons. Buyers to pay harbour-improvement rate or any similar rate which may be imposed by the Government or local authority. This flat rate has been decided upon (in substitution for sale at per unit) consequent upon the fact that the Commissioners make their sales ex islands at a flat rate f.o.b.

The phosphate will be guaranteed to contain phosphoric acid equivalent to a minimum of 80 per cent. of tribasic phosphate of lime (calculated on the normal condition as delivered). Should the percentage of moisture in the moisture sample exceed 5 per cent., an allowance to be made at the rate of 6d. per ton for drying.

Buyers to receive a minimum weight of 500 tons per weather working-day in terms of the charter-party. Demurrage shall be paid by the buyers at the rate of 4½d. per net register ton per day. Despatch-money earned will be for sellers' account, but buyers will be paid their overtime expenses. Railway weights at port of discharge to be accepted.

Payment is to be made in Auckland to Messrs. Henderson and McFarlane, the officially appointed agents for New Zealand, as follows: Three-fourths invoice value on arrival of the vessel, balance on adjustment of weights.

It must be understood that this price refers to sales up to 30th June only, and that, largely in consequence of the condition of the freight market, and a possible variation in f.o.b. cost, the c.i.f. price may be varied as from 1st July onwards.

GRINDING OF THE PHOSPHATE ROCK.

The phosphate rock is quarried on the islands, and there reduced where necessary by rock-breakers to a convenient size for handling. It is shipped in bulk, and an average cargo as delivered in New Zealand into trucks varies from

fine dust to pieces about the size of a man's fist. In this form the phosphate is unsuitable for use as a fertilizer. It has first to be ground, and it has then two main uses: it is either converted into superphosphate or applied directly to the soil alone or in mixtures. For successful employment as a fertilizer in its raw state the phosphate must be very finely ground, much more so than is necessary for conversion to super, and the district must be a suitable one for its use, an adequate rainfall being essential. The standard of fineness is usually indicated by the percentage of any given quantity which will pass through a 100-mesh sieve. For successful employment in top-dressing, or for other direct application to the soil, at least 80 per cent. should pass through a 100-mesh sieve, while the higher the percentage above that the more successful will be the result obtained. Available particulars in regard to the use of ground phosphate rock as a fertilizer may be obtained from the Department.

The phosphate rock quarried is of varying degrees of hardness, but it may be said that in any shipment received there will be a considerable proportion of hard rock, and a plant suitable for reducing this will be necessary. The Department has made many inquiries with a view to having available for reference particulars of suitable plants, from the manufacturers of which any one desiring to erect works could obtain estimates and other information. The following types of grinding-mills are in operation in New Zealand: "Sturtevant": Made by Sturtevant Engineering Company, 147 Queen Victoria Street, London (inquiries in New Zealand to Blair, Reed, and Co., Wellington). "Kent": Made by the Kent Mill Company, 10 Ropelyea Street, Brooklyn, New York, U.S.A. "Maxecon": This is an improved Kent mill. "Fuller Lehigh": Made by the Fuller Lehigh Company, Fullerton, Pennsylvania, U.S.A.

The complete plants consist of a crusher of the rock-breaker type and a grinding-mill, together with elevators and screens for sifting. The price would have to be obtained from the respective firms. In addition, the necessary power to drive the plant would have to be provided, and there would, of course, be the building. It is probably safe to say that one of the plants described could not be put up complete and ready for working under £12,000, unless there was cheap power available and a substantial building was dispensed with.

The New Zealand Phosphate Commissioner recently made inquiries in America and England in regard to grinding plants. He reports that he has been favourably impressed by the particulars of two types of plants brought under his notice, and considers that either should prove eminently suitable. They both employ the principle of the air separation for sifting the ground rock, instead of screens or sieves, and the necessary fineness should therefore be ensured. The firms in question would supply full particulars. They are Raymond Bros., Impact Pulverizing Company, Chicago, U.S.A., and the Sturtevant Engineering Company (referred to previously).

A number of inquiries have reached the Department regarding a smaller plant of a more portable type, suitable for associations of farmers wishing to deal with a comparatively small quantity. A plant which has been successfully employed in grinding the harder class of limestone has been brought under notice, and as soon as the necessary raw material can be obtained the Department will arrange to give it a practical trial in order to determine whether it would grind phosphate rock to the necessary fineness. It must be pointed out, however, that small quantities of rock will necessarily cost more than the price quoted for single shipments of from 4,000 to 6,000 tons, delivered at one of the main ports. If arrangements have to be made for delivering in smaller lots there must be an addition to the price consequent upon extra handling charges.

Noxious Weeds.—The Masterton Borough Council has declared elderberry to be a noxious weed within the meaning of the Act.

Decontrol of Price of Apples in Britain.—The following cablegram has been received from the High Commissioner in London: "Ministry for Food have revoked apple-prices order, so that as from February 14th apples free. Ministry for Food announces that that step has been rendered possible by supplies still available and expected increased quantities to be shipped from Australasia—1,250,000 cases, compared with 830,000 cases last year. They add that, therefore, no reason to apprehend any undue inflation of prices."

WASTE LANDS DEVELOPMENT.

A NEW mode of occupation of Crown lands (somewhat similar to the old "homestead" system) is provided for by section 11 of the Land Laws Amendment Act, 1919. Lands set apart for occupation under that section must be of such a character as cannot be profitably disposed of under any other tenure, and may be disposed of under a license to occupy for a term of ten years, free of rent (subject to right of renewal for a similar term), to residence conditions, and to such improvement conditions as may be prescribed by regulations, which are now in course of preparation. The freehold title may be obtained without payment at any time after seven years from date of license. Advances may be made to licensees for improvements to such amount as may be fixed by regulations. Selectors will, of course, be liable for repayment of loans made for improvements, and for providing access, and the interest thereon. The maximum area of allotments will be 400 acres of second-class or 1,000 acres of third-class land, but in special cases these maxima may be increased to 600 acres and 1,500 acres respectively. Applications for land on this system should be made to the Commissioners of Crown Lands in the Auckland and North Auckland Land Districts.

LAND FOR DISCHARGED SOLDIERS.

THIS month an area of 11,584 acres in Whitianga and Hastings Survey Districts, Auckland, cut into nine holdings, is being offered on Hauraki pastoral license, and discharged soldiers will have preference. In the Taranaki District sixteen holdings, totalling 4,365 acres, in areas ranging from 57 acres to 537 acres, in Totoro, Piopiotea West, Mapara, Pahi, and Hawera Survey Districts, will be opened on 21st March. These lands are suitable for grazing when cleared. In the Westland District a pastoral run on the Styx River, containing 14,000 acres, and six scattered sections, containing 1,906 acres, are being offered on 15th March. In the Otago District the subdivisions of the Teviot Settlement and adjacent runs are being opened on 29th March. The total area is 67,177 acres, and comprises altogether sixty-six holdings. These lands are suitable for pastoral purposes.

Three sections in Glengarry and Wilder Settlements and Tahoraite Survey District, Hawke's Bay, suitable for dairying, are being offered on 12th April. These sections contain respectively 72 acres, 491 acres, and 126 acres. In Southland two lots in the Town of Menzies Ferry and Toetoes Survey District, containing 266 acres, are notified for 19th April. In the North Auckland District, sixteen sections, containing altogether 3,060 acres, will be offered on 18th April. The Hurakia Block, in the Gisborne District, containing five sections of a total area of 3,027 acres, will be offered on 18th April. In the Wellington District eight lots in Hunua, Whirinaki, Retaruke, and Hautapu Survey Districts are being prepared for offering, and will be notified shortly. The total area is 5,710 acres, the areas ranging from 209 acres to 1,626 acres.

FORTHCOMING AGRICULTURAL SHOWS.

Mackenzie County A. and P. Society: Fairlie, 28th March.
Methven A. and P. Association: Methven, 7th April.
Mayfield A. and P. Association: Mayfield, 31st March.
Oxford A. and P. Association: Oxford, 7th April.
Temuka and Geraldine A. and P. Association: Temuka, 14th April.
Otago A. and P. Society: Dunedin, 31st May, 1st to 3rd June (Winter Show).
Waikato Winter Show Association: Hamilton, 31st May, 1st to 4th June.
Franklin A. and P. Society: Pukekohe, 15th to 18th June (Winter Show).
Manawatu and West Coast A. and P. Association: Palmerston North, 21st, 22nd, 23rd, and 24th June (National Dairy Show).

(A. and P. Association secretaries are invited to supply dates and location of their shows.)

DESTRUCTION OF CALVES ON FARMS.

An investigation was carried out recently by the Stock Inspectors of the Department for the purpose of estimating the percentages of calves destroyed on farms throughout the Dominion. The matter is of importance as relating to the future maintenance of the cattle-stock of the country, especially in connection with the dairy industry.

In the Auckland Province such slaughtering of calves was estimated at an average of 57 per cent. in the districts where dairying is the principal industry, and 12 per cent. in the districts where grazing predominates.

The following are the estimated percentages in other parts of the Dominion, the places named being the headquarters of the respective stock-inspectorates: Masterton, 70; Taihape, 5; Carterton, 75; Wanganui, 50; Hastings, 70; Hawera and New Plymouth, 65; Opunake, 66; Wellington, 80; Blenheim, 40; Palmerston North, 40; Woodville, 75; Gisborne, 40; Stratford, 70; Feilding, 60; Nelson, 50; Kaikoura, 65; Rotherham, 1 to 2; Amberley, 51; Christchurch, 75; Lincoln, 95; Ashburton, 45; Timaru, 75; Fairlie, 1; Westland, 35; Waimate, 75; Invercargill, 90; Otautau, 80; Wyndham, 70; Milton, 75; Dunedin, 65; Palmerston, 55; Balclutha, 50; Owaka, 35; Oamaru, Lawrence, Kurow, and Roxburgh, 2 to 10.

In general the high percentages relate to districts where dairying is carried on extensively, while the lower figures represent grazing or fattening districts.

IMPORTATION OF BULBS.

Importers of bulbs, whether in a commercial or private way, should advise their shippers that the regulations requiring each consignment of bulbs to be covered by a freedom-of-disease certificate—temporarily relaxed during the war period owing to the disorganization of the mails—will be strictly enforced with respect to all consignments entering New Zealand after 30th June next. In order to avoid later difficulties in this direction importers are further advised to enclose with each order a certificate form, copies of which may be had on application to the Director of the Horticulture Division, Department of Agriculture, Wellington.

MILKING SHORTHORN YEARLING HEIFERS AT RUAKURA.

TENURE OF LAND OCCUPIED IN NEW ZEALAND: 1919–20.

Land District.	Freehold occupied by Owner.	Leased from Private Individuals.	Leased from Public Bodies.	Leased from Maoris.	Crown Lands.		Tenure not specified.	Total Area occupied.
					Held under Pastoral Lease or License.	Held under other Tenures.		
	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
North Auckland	2,303,504	128,287	38,495	82,674	112,544	333,251	..	2,998,755
Auckland ..	2,525,969	156,076	45,678	455,865	257,048	868,037	..	4,308,673
Hawke's Bay ..	2,760,223	222,800	123,479	706,376	295,017	558,399	..	4,666,294
Taranaki ..	862,125	164,260	56,657	119,318	53,622	449,198	..	1,705,180
Wellington ..	3,175,471	384,491	88,611	409,632	229,422	535,865	..	4,823,492
Nelson.. ..	626,017	56,176	9,420	14,978	168,330	454,444	4	1,329,369
Marlborough ..	835,441	45,776	7,508	27,287	1,271,196	345,590	..	2,532,798
Westland ..	150,990	18,637	5,298	5,129	1,176,968	375,927	..	1,732,949
Canterbury ..	3,152,933	402,575	271,083	11,555	3,777,347	661,415	..	8,276,908
Otago	1,601,085	192,863	88,680	7,258	4,905,524	1,122,618	..	7,918,028
Southland ..	1,489,340	132,296	147,882	6,116	1,110,399	294,600	..	3,180,633
Totals ..	19,483,098	1,904,237	882,791	1,846,188	13,357,417	5,999,344	4	43,473,079
Totals, 1918–19	18,963,106	2,077,884	980,782	1,880,794	12,928,360	6,503,663	8,117	43,342,706

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CALF-REARING.

FURTHER TESTS AT THE EXPERIMENTAL FARMS.

J. L. BRUCE, Superintendent of Experimental Farms.

IN the *Journal* for May last an account was given of a scheme of calf-feeding tests, combined with the best practice in rearing generally, which was carried out at the Department's experimental farms in the 1919–20 season, the object being to secure reliable local data as to what extent supplementary foods (mainly home-grown) could be profitably substituted for milk and whey. Satisfactory and instructive results were obtained, indicating that the produce of the dairy could without detriment be very largely eliminated from the dietary of calves.

During the present season (1920–21) similar tests have been carried out at the several farms, with certain variations in foods and feeding formulas suggested by the previous experience or for widening the data. Particulars of the tests as undertaken at each of the three farms concerned—Ruakura, Weraroa, and Moumahaki—are given in the matter which follows. In each case sixteen calves, divided into four groups of four each, were used, the period of the tests being seventeen or eighteen weeks, as detailed.

In compiling the figures a uniform basis of food-costs has again been adopted so far as possible. Thus the cost of whole milk has been calculated on butterfat at the season's approximate average of 2s. 6d. per pound, together with a test of 3·75 per cent. all round. The supplementary foods—pulse, grain, meal, &c.—are costed at the high level of prices ruling at the beginning of the season and up till recently. All values are, of course, subject to variation, and farmers can readily work out costs in their own case on a suitable basis.

It may be mentioned that as a result of the experience gained in connection with the last and present seasons' tests the Department has decided to undertake a more comprehensive scheme of calf-rearing experiments, and this will be put into operation at the experimental farms next season.

RUAKURA FARM OF INSTRUCTION.

Owing to the very satisfactory results of the tests in the 1919–20 season it was considered unnecessary to purchase ordinary calves from outside for this season's tests. Good strong calves were therefore chosen from the pedigree Milking Shorthorn herd on the farm. Heifer calves were preferred, but as it was not possible to secure the full number at the time the shortage was made up with four bull calves. Three heifers and one bull calf comprised each of the four groups.

The conditions under which all the groups of calves were reared were alike. The advantage to be gained by feeding three times daily over twice daily was clearly demonstrated by the last experiments conducted, and this method was again observed. All calves were weighed on the same day, fed at the same time daily, and grazed on the same field. A shed was provided for shelter at nights for the first month. The calves grazed on a clean pasture of Western Wolths rye-grass, red clover, alsike clover, and white clover. Clean drinking-water was always available, also a salt lick. There were no deaths, and all calves finished up in excellent health.

It may be noted that the calves made higher increases in weights than those recorded in the previous test. To some extent this may be attributed to the higher-bred quality of the young animals. All were from sires and dams possessing excellent constitution and true Shorthorn character. Another factor which may have influenced increased weights was the large clover-content of the grazing-pasture. The calves fed on crushed oats and skim-milk made the heaviest gains, but those fed on whole linseed and flour had the better appearance.

Group 1.

Food formula: Whole milk, 8 lb. per day for two weeks; whole linseed 8 oz., flour 2 oz., plus skim-milk 15 lb., per day for fifteen weeks.

Preparation: Whole linseed soaked overnight in water and boiled for twenty minutes next day; flour mixed with a little water and added five minutes before boiling completed.

Weights and gains: Four calves—total first weight, 374 lb.; total final weight (seventeen weeks), 1,294 lb.; total gain, 920 lb.; average daily gain of each calf, 1·93 lb.

Quantities and cost of food per head: Whole milk, 112 lb.=4·2 lb. butterfat at 2s. 6d. per pound, 10s. 6d.; whole linseed, 52½ lb. at 4d.

per pound, 17s. 6d.; flour, 13⅛ lb. at 15s. per 100 lb., 2s.; skim-milk, 157½ gallons at 1d. per gallon, 13s. 1½d.: total cost of food per head for period of test, £2 3s. 1½d.

Group 2.

Food formula: Whole milk, 8 lb. per day for two weeks; crushed oats 1 lb., plus skim-milk 15 lb., per day for fifteen weeks.

Preparation: Crushed oats stirred into the skim-milk immediately before feeding.

Weights and gains: Four calves—total first weight, 376 lb.; total final weight, 1,350 lb.; total gain, 974 lb.; average daily gain of each calf, 2·04 lb.

Quantities and cost of food per head: Whole milk, 112 lb.=4·2 lb. butterfat at 2s. 6d. per pound, 10s. 6d.; crushed oats, 105 lb. at 2d. per pound, 17s. 6d.; skim-milk, 157½ gallons at 1d. per gallon, 13s. 1½d.: total cost of food per head for period of test, £2 1s. 1½d.

Group 3.

Food formula: Whole milk, 8 lb. per day for two weeks; crushed linseed 9 oz., plus hay-tea 15 lb., per day for fifteen weeks.

Preparation: Dry crushed linseed stirred into the hay-tea immediately before feeding. Hay-tea prepared by boiling chaffed lucerne hay—1 lb. of hay to 1½ gallons of water. Hay-tea fed warm.

Weights and gains: Four calves—total first weight, 369 lb.; total final weight, 1,141 lb.; total gain, 772 lb.; average daily gain of each calf, 1·62 lb.

Quantities and cost of food per head: Whole milk, 112 lb.=4·2 lb. butterfat at 2s. 6d. per pound, 10s. 6d.; crushed linseed, 59 lb. at 4d. per pound, 19s. 8d.; hay, 105 lb. at £7 per ton, 6s. 7d.: total cost of food per head for period of test, £1 16s. 9d.

Group 4.

Food formula: Whole milk, 8 lb. per day for two weeks; crushed linseed 9 oz., plus skim-milk 15 lb., per day for fifteen weeks.

Preparation: Dry crushed linseed stirred into the skim-milk immediately before feeding.

Weights and gains: Four calves—total first weight, 363 lb.; total final weight, 1,237 lb.; total gain, 874 lb.; average daily gain of each calf, 1·83 lb.

Quantities and cost of food per head: Whole milk, 112 lb.=4·2 lb. butterfat at 2s. 6d. per pound, 10s. 6d.; crushed linseed, 59 lb. at 4d. per pound, 19s. 8d.; skim-milk, 157½ gallons at 1d. per gallon, 13s. 1½d.: total cost of food per head for period of test, £2 3s. 3½d.

WERAROA CENTRAL DEVELOPMENT FARM.

The calves used were of mixed breeds—Shorthorn, Jersey, Friesian, Hereford, and Guernsey crosses—and as near as possible the different crosses were divided into different groups. As in the previous season, the calves were purchased locally, and delivery taken within twenty-four hours of birth, in order to have complete control of each animal from the start.

TOP—GROUP I, RUAKURA. MIDDLE—GROUP 2, WERAROA. BOTTOM—GROUP I, MOUMAHAKI.

Owing to adverse climatic conditions—a late wet spring—the paddock set aside for the carrying-out of the tests proved unsatisfactory, the young grass sown the previous autumn not having made sufficient progress, especially the clover, which did not come on until late in the season. The experience gained in the past two seasons has shown that a good mixture of clover in the young pasture is most essential in the rearing of calves under the conditions of these tests.

As in the previous test, a control group—in this case No. 3—was fed under what might be termed the ordinary farmer's method—that is, linseed gruel and milk being used throughout. It was noticed from the beginning of the test that the calves in groups 1 and 3 took their rations readily. In group 2 (oats and bran) the calves refused the ration right from the commencement, although every effort was made to induce them to feed. Fresh oats and bran were continually placed before the calves, but little, if any, was actually eaten. This point must not be overlooked in the comparison of costs, which latter are included in full. In group 4 it was noticed that the addition of bean-meal was not relished, and the calves had to be encouraged to feed.

The transition from one feed to another—whole milk to skim-milk and the substitution of supplementary foods—was made gradually in each case, in order to avoid as far as possible checks to the animals' development.

Every care was again taken to ensure a good supply of fresh water and clean feeding-utensils, and there was an entire absence of scouring among the calves.

Group 1.

Food formula: Whole milk, 8 lb. per day for two weeks; skim-milk, 16 lb. per day for two weeks; pea-meal 4 oz., and linseed-meal 6 oz., per day for fourteen weeks.

Preparation: Whole linseed soaked overnight in water. Pea-meal added next day, and the whole boiled for twenty minutes.

Weights and gains: Four calves—total first weight, 307 lb.; total final weight (eighteen weeks), 718 lb.; total gain, 411 lb.; average daily gain of each calf, 0·81 lb.

Quantities and cost of food per head: Whole milk, 112 lb. = 4·2 lb. butterfat at 2s. 6d. per pound, 10s. 6d.; skim-milk, 22½ gallons at 1d. per gallon, 1s. 10½d.; pea-meal, 24½ lb. at 2d. per pound, 4s. 1d.; linseed-meal, 36¾ lb. at 4d. per pound, 12s. 3d.: total cost of food per head for period of test, £1 8s. 8½d.

Group 2.

Food formula: Whole milk, 8 lb. per day for two weeks; skim-milk, 16 lb. per day for two weeks; bran 4 oz., and crushed oats 1 lb., per day for fourteen weeks.

Preparation: Crushed oats and bran fed dry.

Weights and gains: Four calves—total first weight, 264 lb.; total final weight, 660 lb.; total gain, 396 lb.; average daily gain of each calf, 0·78 lb.

Quantities and cost of food per head: Whole milk, 112 lb. = 4·2 lb. butterfat at 2s. 6d. per pound, 10s. 6d.; skim-milk, 22½ gallons at 1d. per gallon, 1s. 10½d.; bran, 24½ lb. at 9s. per 100 lb., 2s. 2d.; crushed oats, 89 lb. at 2d. per pound, 16s. 4d.: total cost of food per head for period of test, £1 10s. 10½d.

Group 3.

Food formula: Whole milk, 8 lb. per day for two weeks; skim-milk, 16 lb. per week for sixteen weeks, plus linseed gruel, 1 quart per day for fourteen weeks.

Preparation: ½ lb. of linseed in ½ gallon of water, boiled to a jelly.

Weights and gains: Four calves—total first weight, 269 lb.; total final weight, 834 lb.; total gain, 565 lb.; average daily gain of each calf, 1·12 lb.

Quantities and cost of food per head: Whole milk, 112 lb. = 4·2 lb. butterfat at 2s. 6d. per pound, 10s. 6d.; skim-milk, 179 gallons at 1d. per gallon, 14s. 11d.; linseed-meal, 24½ lb. at 4d. per pound, 8s. 2d.: total cost of food per head for period of test, £1 13s. 7d.

Group 4.

Food formula: Whole milk, 8 lb. per day for one week; skim-milk, 16 lb. per day for one week; bean-meal 8 oz., and linseed-meal 6 oz., well cooked and fed with 3 quarts of warm water, per day for sixteen weeks.

Preparation: Boiling water 30 quarts, added to 3 quarts of linseed-meal, plus 4 quarts of bean-meal, the whole mixed and covered for twenty-four hours.

Weights and gains: Three calves*—total first weight, 224 lb.; total final weight, 571 lb.; total gain, 347 lb.; average daily gain of each calf, 0·92 lb.

Quantities and cost of food per head: Whole milk, 56 lb. = 2·1 lb. butterfat at 2s. 6d. per pound, 5s. 3d.; skim-milk, 11 gallons at 1d. per gallon, 11d.; bean-meal, 56 lb. at 2d. per pound, 9s. 4d.; linseed-meal, 42 lb. at 4d. per pound, 14s.: total cost of food per head for period of test, £1 9s. 6d.

MOUMAHAKI EXPERIMENTAL FARM.

The calves used in the tests were purchased, and were mainly of Shorthorn breeding, although several showed traces of Jersey blood.

With the exception of one calf which did not readily eat crushed oats no difficulty was experienced in the feeding. Throughout the period the calves had the run of a field of new grass, and shelter was provided to which they had free access.

Group 1.

Food formula: Whole milk, 8 lb. per day for two weeks; skim-milk, 8 lb. per day for two weeks; bean-meal 3¾ oz., and ground linseed 2¼ oz., per day for thirteen weeks.

Preparation: Meals soaked in boiling water for twenty-four hours, and all foods fed to calves at blood-heat.

Weights and gains: Four calves—total first weight, 208 lb.; total final weight (seventeen weeks), 721 lb.; total gain, 513 lb.; average daily gain of each calf, 1·12 lb.

Quantities and cost of food per head: Whole milk, 112 lb. = 4·2 lb. butterfat at 2s. 6d. per pound, 10s. 6d.; skim-milk, 11 gallons at 1d.

* In this group the fourth calf did not complete the test.

per gallon, 11d.; bean-meal, 21 lb. at 2d. per pound, 3s. 6d.; ground linseed, 13 lb. at 4d. per pound, 4s. 4d.: total cost of food per head for period of test, 19s. 3d.

Group 2.

Food formula: Whole milk, 8 lb. per day for two weeks; skim-milk, 8 lb. per day for two weeks; maize-meal 3 oz., and ground linseed 3 oz., per day for thirteen weeks.

Preparation: Meals soaked in boiling water for twelve hours, and boiled for twenty minutes before feeding.

Weights and gains: Four calves—total first weight, 296 lb.; total final weight, 700 lb.; total gain, 404 lb.; average daily gain of each calf, 0·88 lb.

Quantities and cost of food per head: Whole milk, 112 lb. = 4·2 lb. butterfat at 2s. 6d. per pound, 10s. 6d.; skim-milk, 11 gallons at 1d. per gallon, 11d.; maize-meal, 17 lb. at 2d. per pound, 2s. 10d.; ground linseed, 17 lb. at 4d. per pound, 5s. 8d.: total cost of food per head for period of test, 19s. 11d.

Group 3.

Food formula: Whole milk, 8 lb. per day for two weeks; skim-milk, 8 lb. per day for two weeks; oatmeal 3 oz., and linseed-meal 3 oz., per day for thirteen weeks.

Preparation: Meals soaked in boiling water for twelve hours, and boiled for twenty minutes before feeding.

Weights and gains: Four calves—total first weight, 303 lb.; total final weight, 578 lb.; total gain, 275 lb.; average daily gain of each calf, 0·61 lb.

Quantities and cost of food per head: Whole milk, 112 lb. = 4·2 lb. butterfat at 2s. 6d. per pound, 10s. 6d.; skim-milk, 11 gallons at 1d. per gallon, 11d.; oatmeal, 17 lb. at 4½d. per pound, 6s. 4½d.; linseed-meal, 17 lb. at 4d. per pound, 5s. 8d.: total cost of food per head for period of test, £1 3s. 5½d.

Group 4.

Food formula: Whole milk, 8 lb. per day for ten days; skim-milk, 8 lb. per day for eleven days; linseed-meal, 1 oz. per day for fourteen weeks, plus crushed oats, 1 oz. per day for four weeks, and 3 oz. per day for ten weeks.

Preparation: Linseed-meal prepared just before feeding by mixing to a thin paste with boiling water; crushed oats fed dry.

Weights and gains: Four calves—total first weight, 318 lb.; total final weight, 794 lb.; total gain, 476 lb.; average daily gain of each calf, 1·04 lb.

Quantities and cost of food per head: Whole milk, 80 lb. = 3 lb. butterfat at 2s. 6d. per pound, 7s. 6d.; skim-milk, 9 gallons at 1d. per gallon, 9d.; linseed-meal, 6⅛ lb. at 4d. per pound, 2s. 0½d.; crushed oats, 15 lb. at 2d. per pound, 2s. 6d.: total cost of food per head for period of test, 12s. 9½d.

Fencing Act.—The maximum prices payable in respect of the half cost of erecting certain kinds of fence, as may be required under the Fencing Act, have been amended by an Order in Council gazetted on 3rd March. The special powers of the Executive in this matter are conferred by section 21 of the War Legislation Amendment Act, 1916.

MORTALITY IN DRIVEN STOCK.

RECENT CASES OF POISONING.

B. C. ASTON, F.I.C., F.N.Z.Inst., Chemist to the Department.

Two interesting cases of heavy mortality in stock which were being driven to the slaughteryards have recently been investigated by the writer.

POISONING OF SHEEP BY SODA.

In the first case a mob of 775 sheep were consigned by rail after having been driven twenty-nine miles in three days. After their arrival at the works ten of them died in the yards; the remainder were taken to pasture, where the mortality continued. Apparently the sheep were then brought back to the works for killing, and deaths continued to take place. Some eighty altogether died from unexplained cause.

The following are notes of the symptoms and of the *post mortem* examination made by Mr. H. A. Reid, F.R.C.V.S., Officer in Charge of the Wallaceville Laboratory: "Symptoms are indefinite. The sheep appear to stagger, and respirations are greatly accelerated prior to death. Rigor mortis sets in very rapidly. The sheep brought to me were two full-mouthed Lincoln wethers in very well nourished condition. *Post mortem* examination disclosed congestion of the subcutaneous veins, the blood having clotted imperfectly. On opening the abdominal cavity, the small intestines were seen to be congested, having numerous ecchymoses on their serous surface. The gall-bladder in one of the sheep was greatly distended with dark-green bile. Some occlusion of the bile-ducts was evident, the surrounding liver-tissue being deeply bile-stained. Bile-staining was also present in the omental fat, and a large amount of bile had collected in the bowel. The liver was congested, but firm in texture. The abomasum presented a striking appearance, much more marked in one of the sheep than the other. In the more acute case the abomasum was filled with dark blood-stained fluid contents. The mucous surface was intensely congested and hæmorrhagic over almost the entire surface. In the other case this congestion was well marked, though less acute. Lesions in the bowels coincided with those seen in the fourth stomach, the degree of congestion diminishing gradually as the bowel was traced back from the duodenum. The kidneys appeared to be slightly congested. The spleen was normal in size and consistence. The heart and lungs showed no abnormality beyond hypostatic congestion of the latter, and venous engorgement, which one would expect to find in a dead animal. There was a moderate proportion of nematode worms in the abomasum—nothing abnormal. Eosinophilia was absent on examination of blood-smears, so that parasitism cannot be held responsible. The blood appeared on examination to be sterile, and normal in other respects. Sections of liver and kidneys have been

retained for section and microscopic examination. The intense gastro-enteritis, which is the most striking feature observed, in conjunction with the other factors mentioned, leads me to suspect that some irritant poison has been absorbed, and is accountable for the mortality."

On examination at the Chemical Laboratory the contents of the fourth stomach (abomasum) were found to be quite alkaline to litmus and to effervesce slightly on the addition of acid. A portion of the aqueous extract of the stomach on evaporation deposited crystals of sodium carbonate. No lead, phosphorus, antimony, arsenic, mercury, or other common metallic poison could be found in the liver or stomach-contents. The amount of alkali found would amply account for the *post mortem* symptoms observed, such compounds being gastric irritants. The length of time which elasped—assuming that the animals all took the poison at the same time—between the taking of the poison and death would coincide with what is known of the action of the corrosive alkalies when taken internally. Wynter Blyth states that the patients suffering from this form of poisoning may linger for days, weeks, or months.

The lesson to be learnt from this case is to avoid leaving any sort of alkaline or corrosive sodium compound, such as caustic or washing soda, in the way of domestic animals. Alkaline effluents discharged by factories should not be accessible to stock. In the present case it has not been discovered where the sheep picked up the soda, but the fact that they did get it somewhere cannot be doubted.

No case of poisoning of sheep by caustic alkali has hitherto come under the writer's notice, although cases in pigs and calves which might be attributed to this cause have frequently been submitted for investigation of late years. Owing to the growth of the dairy industry waste products from dairy factories have become staple foods for young animals. These waste products frequently contain an excess of sodium salts, which have an alkaline reaction, and when introduced into the animal have a corrosive effect on the mucous surfaces. The sodium salts have been added to neutralize the lactic acid of the milk or cream as the case may be, and the resultant waste product also contains sodium lactate. It is possible that this also has some action on pigs. Farmers should be extremely careful not to feed any animals on waste products, such as skim-milk, buttermilk, or whey, having an alkaline reaction; but the question whether such a product is alkaline or not is best determined by the factory-manager, who should be careful not to send any waste product to farmers which may cause extensive mortality in stock.

CATTLE POISONED BY RANUNCULUS (BUTTERCUP).

The next case is in many particulars similar to those quoted in the *Journal* for June, 1918, p. 325. About one hundred head of cattle left Wairarapa on a Wednesday night and camped on Thursday night at Upper Hutt. On Friday one died on the road; "frothing at the mouth, going mad, and death in a few minutes," were the symptoms as described by the drover. The mob pushed on to accommodation-paddock at Taita, where two more died after arrival. They had the same frothing-at-the-mouth symptoms, and staggering gait as if they had no control of the hind quarters. On examination by Mr. E. E. Elphick, Government Veterinarian, it was found that one bullock had a

blood-discharge from the rectum and the nose, and the body was blown up; the other did not show anything abnormal, and both had apparently died without a struggle. A post-mortem was made on the first bullock. The Veterinarian found the stomach-contents mostly grass with a sprinkling of leaves, chiefly willow, and an old portion of leaves which resembled tutu, but in very small quantity; various seeds were also present to a small amount. Small petechiæ (red patches) were present throughout the alimentary tract, being most pronounced in the small intestine, which showed large inflammatory patches. The liver was enlarged, fatty, of pale colour and very friable. The kidneys were apparently normal. There was nothing abnormal in stomach appearance. In all, fourteen beasts were affected, and three died.

On examination in the Chemical Laboratory the writer found undoubted tutu-leaves in the stomach-contents, and seeds of a species of *Ranunculus* (probably an introduced species). No mineral poison could be found in the stomach-contents or the liver. Poisoning by tutu would not account for this inflammatory condition of the intestines. The strong resemblance to the cases already recorded from cattle driven over the range suggests that *Ranunculus* seeds, leaves, stems, and roots were responsible for this mortality.

Willow and buttercups grow in damp places by the Hutt River, and a hungry mob of cattle herded in a limited area would eat greedily of any food within reach, and would not be overparticular as to the palatability. In some cases the roots would no doubt be consumed. These are considered to be more poisonous than the stems or leaves. The small red patches in the alimentary tract would probably be caused by the highly irritant seeds.

There can be little doubt about the toxicity of the species of *Ranunculus*—the buttercup family—although their abundance in all moist pastures and even in the hay may cause hesitation in some farmers' minds in admitting their poisonous nature. Stock which are not ravenously hungry will not eat the green *Ranunculus* in quantity, and certainly not the more acrid root or seeds if they can possibly avoid them. The poison is altered on drying and apparently rendered inert, for buttercups in hay or even when partially dried do not seem to have caused any trouble.

According to Basiner the acrid oil of *Ranunculus* acts in warm-blooded animals as an acrid narcotic, in small doses producing stupor and slow respiration, in larger doses also paralysis of the posterior and anterior extremities, and before death convulsions of the whole body. The acrid action is shown by a corrosive gastritis and by hyperæmia of the kidneys, more particularly of the cortical substance.

GENERAL CAUTION.

In dry weather when feed is short and the stock are driven long distances it is important that drovers should be extremely careful as to the paddocks they choose for resting their stock in, and the sources from which the stock are allowed to water or graze. Failure to observe every precaution with tired and extremely hungry and thirsty animals will undoubtedly result in many cases of mortality.

PHORMIUM TENAX.

THE NEW ZEALAND FIBRE INDUSTRY.

ESMOND H. ATKINSON, Biological Laboratory, Wellington.

II. BOTANICAL.

THE genus *Phormium* belongs to the family *Liliaceae*, which includes such well-known garden-plants as the onion, asparagus, lily, and tulip, while in New Zealand it is represented by several plants, which, like phormium itself, often constitute a very conspicuous feature of the vegetation—*i.e.*, the various species of *Cordyline*, popularly called cabbage-trees, and of *Astelia*, which are generally known as kauri-grass or bush-flax.

DISTRIBUTION OF THE GENUS AND SPECIES.

The genus *Phormium*, which is confined to New Zealand and Norfolk Island, is generally considered to comprise two species, *P. tenax* Forster* (Fig. 1) and *P. Colensoi* J. D. Hooker (Fig. 2), the former having the range of the genus, while *P. Colensoi* is endemic in New Zealand.

Phormium tenax has a wide range in the New Zealand biological area. It is found in both main Islands from the North Cape southwards, and also in Stewart Island and the Chatham Islands. In the Auckland Islands it occurs as a naturalized plant at Port Ross, having been planted there many years ago by Maori sealers. Its range in altitude is from sea-level to perhaps 4,000 ft. in the North Island. It grows in a great variety of stations, including lowland swamps and alluvial flats, sandhills, hillsides, and cliffs.

Phormium tenax is most abundant in the North Island, and very large areas of it occur in the Manawatu and Waikato districts (the former containing the largest phormium swamps in New Zealand), as well as less extensive ones in North Auckland, Taranaki, and Hawke's Bay. In the South Island, Nelson, eastern Otago, and Southland are its chief strongholds at present, little remaining of the former large area in Canterbury except in the north of the province.

The present distribution of phormium is no true record of the place it occupied in primitive New Zealand, many of the so-called swamps having had but little phormium in them until they were drained. In other words, much phormium is now just as truly an agricultural crop as is a cocksfoot pasture.

Phormium Colensoi,† which is generally called "mountain-flax," is found in both Islands, and ascends considerably higher than its congener; it is also a common plant of sea-cliffs in both Islands. It is

* The word "phormium" is from the Greek *phormos* (a basket), in reference to one of the original uses of the plant. The specific name is from the Latin *tenax* (tough), and refers, of course, to the fibre.

† This is the species described in Cheeseman's "Manual of the New Zealand Flora" under the name of *P. Cookianum* Le Jolis, which is the one that has been generally applied to it of late years by botanists. This name, however, is really a synonym of *P. tenax*.

FIG. I. PHORMIUM TENAX FORSTER.

FIG. 2. PHORMIUM COLENSOI J. D. HOOKER.

of little commercial value at present, as its fibre is comparatively weak, and it is mentioned here chiefly to show the relationships existing between it and *P. tenax*. The fibre is, however, very white, soft, and silky, and it is possible that with improved stripping processes it may be very valuable for certain purposes.

As a rule *P. Colensoi* may be easily distinguished even in the flowerless stage by its much smaller and generally less rigid yellowish-green leaves, which seldom have any red colour on the midrib or margins. The flowers, too, are paler in colour as a rule, but the most striking difference between the two plants is seen in the pods or seed-capsules, which in *P. tenax* are from 2 in. to 4 in. long, upright and triangular in section, while in *P. Colensoi* they are nearly twice the length, pendulous and twisted, and round in section. (Fig. 3.)

THE POLYMORPHISM OF PHORMIUM.

Although in the standard botanical works hitherto published on the flora of New Zealand the genus *Phormium* has been considered to consist of but two easily recognizable species—this classification being for the sake of convenience the one here adopted—it should be clearly understood that such an arrangement is to a large extent artificial. Any one who takes the trouble to make a comparative examination of phormium over a large area cannot fail to come across many plants which he will not be able to refer unquestionably to either of the main types here described and figured.

The polymorphism of phormium has long been known, and recent researches* have shown that in certain localities an unbroken series of forms exists connecting the group, which is broadly characterized by large size, upright habit, strong fibre, and erect pods, with a second distinguished roughly by its smaller size, lax habit, weaker fibre, and drooping pods. To enumerate these various forms would be out of place here. Those interested will find an abstract in the above-quoted paper of the work done in this direction, which in its present stages appeals chiefly to the systematic botanist and plant-breeder. Ultimately, no doubt, when more is known of the subject, and various races of phormium are cultivated, each for some particular fibre—disease-resistant or other quality—names will be given to them all, as is now done in the case of cereals and many other agricultural plants.

It should perhaps be stated here that the Maori classification was quite an artificial one, being based on the single character of strength of fibre, so that forms which botanically are widely separated are under their system classed together.

GENERAL DESCRIPTION OF THE SPECIES (FIGS. 4, 5, 6, AND 7).

The species agree in having short, horizontally creeping stems or rootstocks about as thick as the wrist, which give off stout fleshy roots which vary from a few inches to several feet in length and are of a reddish-yellow colour. These roots mostly spread in a horizontal direction near the surface and (particularly in dry stations) have abundant root-hairs through which they absorb water. Some of the roots,

* See paper entitled "Investigations on Phormium," by Miss B. D. Cross, M.A., "Transactions of the New Zealand Institute," Vol. xlvii.

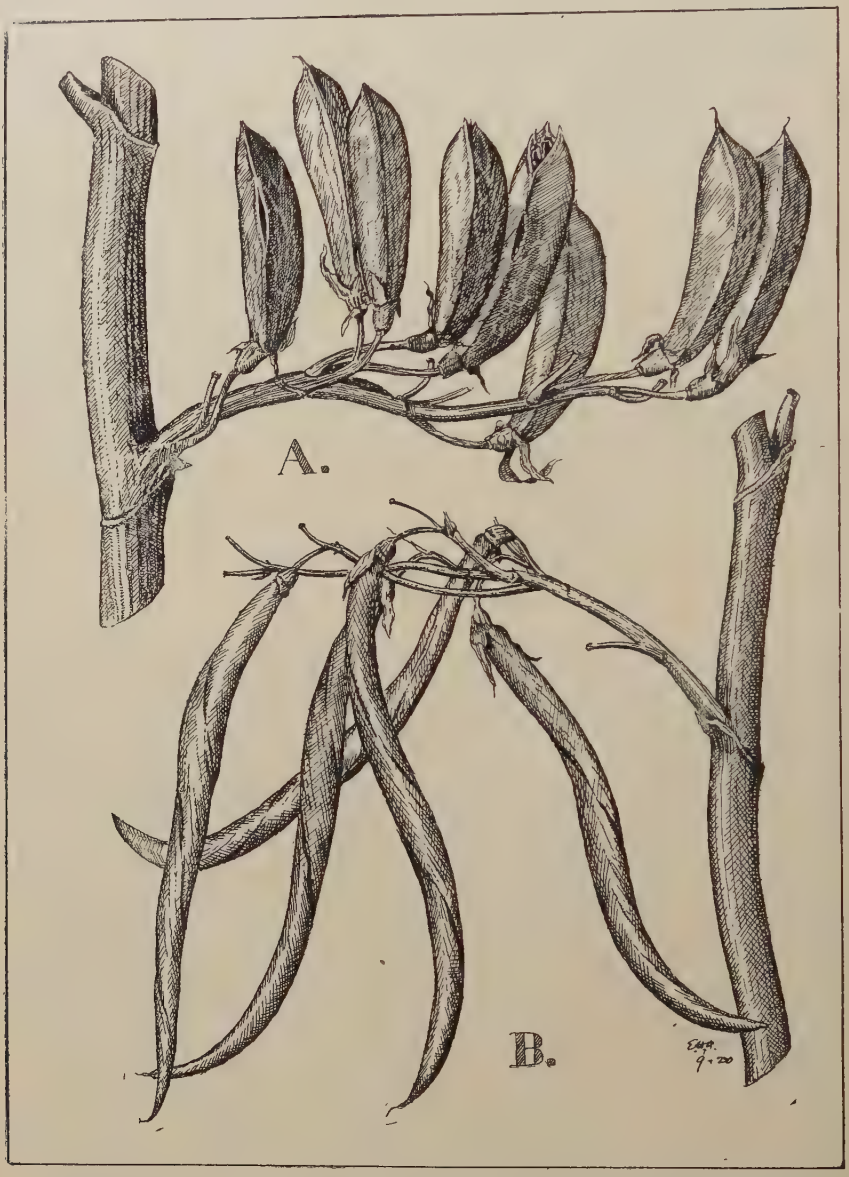


FIG. 3. SHOWING DIFFERENCE IN SEED-PODS OR CAPSULES OF PHORMIUM TENAX (A) AND PHORMIUM COLENSOI (B).

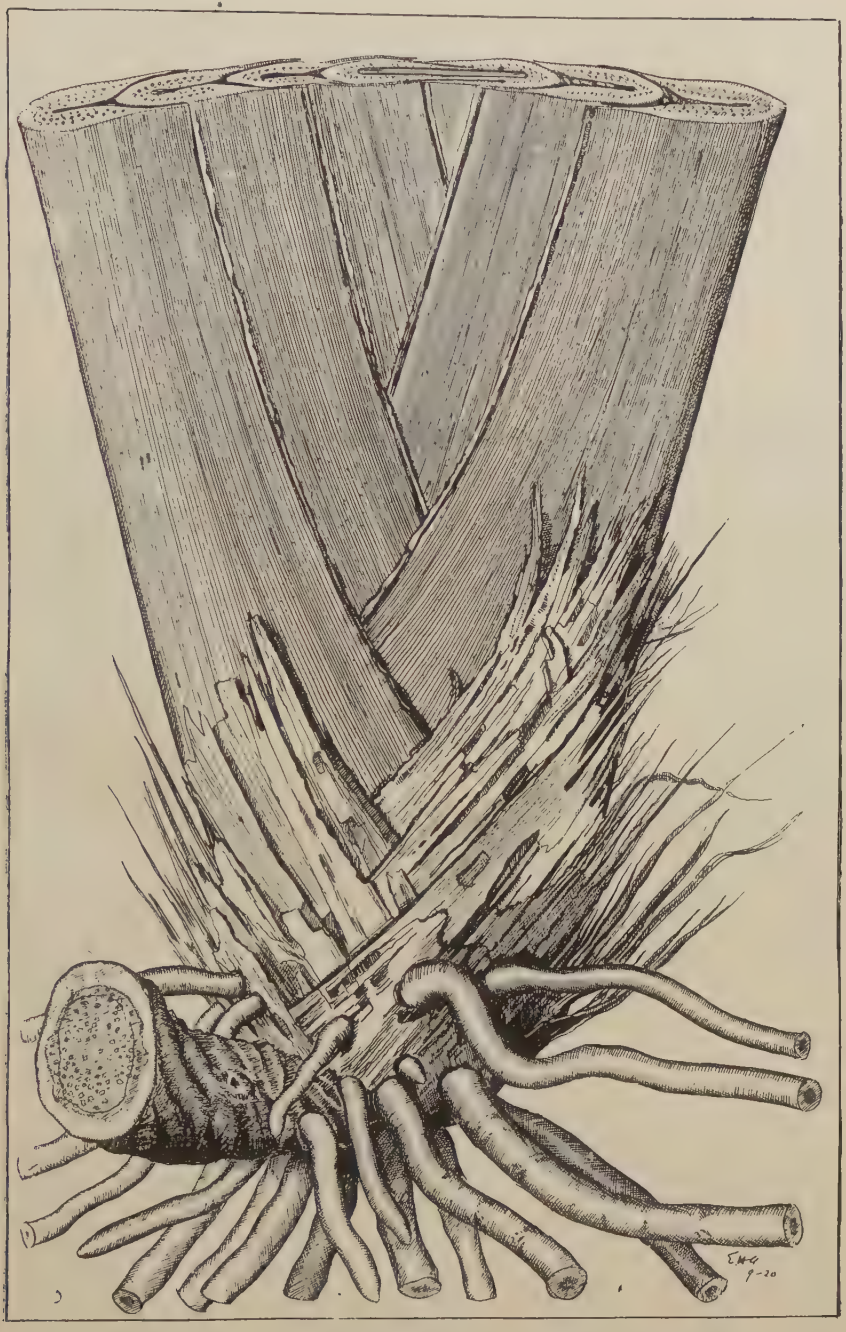


FIG. 4. BASE OF A "FAN" OF PHORMIUM TENAX, SHOWING RHIZOME FROM WHICH IT HAS SPRUNG, ROOTS, AND LEAF-BUTTS. HALF NATURAL SIZE.

This illustration also shows roughly the height at which the leaves are cut off for milling.

however, descend more deeply ; these are not provided with root-hairs, but absorb water through the epidermis, which is very thin towards the apex of the root. The effect of drought on a phormium-plant growing in a dry station is to kill the root-hairs and prevent further water-absorption. Stagnant water may have a precisely similar effect on a plant growing in a swamp, through destroying the water-absorbing tissues of the deep roots. As the plant increases in age the rootstocks branch freely, chiefly in a direction away from its centre, and as abundant roots are produced there is a tendency towards the formation of a number of plants independent of the original rootstock. Ultimately, on the death and decay of the latter, a more or less complete ring of plants which have originated in this way may often be seen. (Fig. 5.)

FIG. 5. RECENTLY CUT PLANT OF PHORMIUM TENAX IN WHICH THE OLDEST "FANS" HAVE DIED OUT, LEAVING A RING OF YOUNGER ONES.

There is no upright stem, the leaves springing in groups direct from the ends of the rootstocks. Each group usually consists of about eight leaves (although as many as thirty have been known in exceptional cases) arranged in the form of a fan, the youngest being in the centre and the oldest at the outsides. Each leaf is folded on itself along the midrib, with the upper surface innermost, while on the lower or outermost surface the midrib forms a sharp keel along the back of the leaf. Leaves of each group are arranged in two sets facing each other, one on either side of the growing-point, the thickened and roughly V-shaped base of each leaf enclosing a younger one in its fold. The entire group of leaves thus forms a "fan," small at its base but rapidly spreading

above, which, owing to the folding of the leaves at their bases and the peculiar way in which they ensheath one another in one plane, is very thin in proportion to its width, the largest fan never being more than a few inches through even at the base, where the thickened butts of the leaves form a bulb-like expansion. The sheathing bases contain a clear gum, which is somewhat bitter to the taste.

The flower-stalk grows out from the centre of the fan, which dies after flowering has taken place. During the flowering season the stalk is very heavy and full of sap, though it afterwards dries and becomes extremely light. The upper portion alone bears the flowers, which are carried on short branches growing out alternately on opposite sides of the main axis and all lying in one plane (Fig. 6). The flower-buds are protected by large bracts which later fall off. The flowers are of various shades of deep red in *P. tenax*, while in *P. Colensoi* they are generally yellowish. Each flower consists of six leaves (*a* and *b*, Fig. 6) arranged in the form of a curved tube from 1 in. to 2 in. long, the three innermost leaves (*b*) being more or less recurved at their tips. Inside this tube and inserted at its base are six stamens, the filaments (*c*) of which are long enough to carry the anthers (*f*) beyond the mouth of the flower. Three of these stamens are considerably longer than the remaining ones. Inside the ring of stamens is the three-celled ovary (*d*) (which later becomes the pod), containing many ovules, which develop into seeds after fertilization. The summit of the ovary is continued into a slender style (*e*), which is usually about the same length as the three shorter stamens.

Both species are in flower from about November to January, and in both, according to certain authorities, the pollen in any individual flower is usually ripe before the stigma of the same flower is ready to receive it, this consecutive ripening of the male and female elements in the same flower being a common contrivance in many plants to guard against self-pollination. Cross-pollination in the genus *Phormium* is now chiefly effected by bees, which are attracted to the flower by the large quantity of nectar secreted. The pollen, being light and powdery, is also adapted for dispersal by the wind, and cross-pollination is no doubt brought about in this way as well. The tui and bell-bird (both honey-eaters) were at one time frequent visitors to phormium swamps in the flowering season, the flowers often being ruptured by them in their anxiety to reach the honey. They may still often be seen in the swamps, but in many districts such birds as starlings and blackbirds have largely replaced them.

As already stated, the "pods" or capsules of the two species differ greatly in appearance, but they agree in splitting when ripe into three valves (A, Fig. 7), and in containing numerous shining black seeds (B and C, Fig. 7), which, from their flattened shape, are adapted for dispersal by the wind. When germination takes place the radicle or rudimentary root pushes its way out of the seed and into the earth. Considerable growth soon occurs at that part of the young plant nearest the seed, and it becomes green and curves into the form of an arch which appears above the soil (D, Fig. 7). This arch then splits along one side, and the tip of the first true leaf emerges; it is soon followed by others, and a thickening appears at their bases corresponding to the mature fan of leaves. The first root-system is of the tap-root type,

FIG. 6. ON LEFT: PORTION OF PANICLE OF PHORMIUM TENAX, SHOWING FLOWERS AND UNRIPE CAPSULES; HALF NATURAL SIZE. ON RIGHT: ABOVE, WHOLE PANICLE, GREATLY REDUCED; BELOW, DETAILS OF FLOWER, NATURAL SIZE.

For explanation of lettering see text, page 209.

but it persists only for a short time and is then replaced by numerous shallow roots growing out from just below the base of the leaves, thus closely resembling the root-system of the mature plant.

TECHNICAL DESCRIPTION OF PHORMIUM TENAX.

The following, taken from Cheeseman's "Manual of the New Zealand Flora," is the technical description of *Phormium tenax* Forst.: "Leaves 3–9 ft. long or more, 2–5 in. broad, linear-ensiform, acute or acuminate, apex split when mature, distichous and equitant at the base, flat above, keeled, very tough and coriaceous dark green above, often glaucous beneath, margins and midrib bordered with a red or orange

FIG. 7. (A) DIFFERENT TYPES OF CAPSULES OF PHORMIUM TENAX. (B) SEEDS, × 2; ONE IN SECTION. (C) SAME, NATURAL SIZE. (D) YOUNG SEEDLINGS, × 2.

line. Scape very variable in height, 5–15 ft., glabrous, terete, reddish-purple. Flowers numerous, 1–2 in. long, usually dull red. Inner perianth-segments erect or slightly recurved at the tip. Capsule erect or inclined, stout, trigonous, 2–4 in. long, not twisted." In the course of some general remarks on the plant Cheeseman states: "*P. tenax* varies much in size, the colour of the leaf, and the extent to which it is recurved and split at the tip, the tint of the coloured line bordering the margins and midrib, the colour of the flowers, and size of the capsule. Some of the varieties also differ considerably in the strength of the fibre."

It is obvious that the above-quoted description cannot be applied to any individual plant—no one individual, for instance, possessing

flower-stalks varying in height from 5 ft. to 15 ft.—but it must be taken as quite a general one, covering all those forms that may conveniently be included under the name of *Phormium tenax*.

The Leaf.

The description of the general appearance of the leaves given above refers chiefly to their arrangement in the fan. As the leaves are the most important part of the plant from the economic point of view it is advisable to describe their appearance and structure a little more fully. The leaves are sword-like in shape, particularly in those races in which their rigidity is a characteristic. The range in length is from 3 ft. to 14 ft., and in breadth from 1 in. to 5 in. In some forms the apex is quite blunt, while in others it is sharply pointed.

Owing to the manner of its longitudinal folding along the midrib the leaf is broadly V-shaped in section in the upper part of the blade, but the two sides gradually converge, and at a distance from the base of a little more than a third of the leaf (though this ratio is a variable one) there is actual coherence of their upper surfaces. This continues nearly to the base, where the two sides are forced apart by the butt of the next leaf. In the young leaves the midrib curves upwards towards the junction of the margins at the apex, giving the blade a boat-shaped appearance, which is emphasized by the keel-like midrib on the lower side. This appearance is not permanent, however, as the apex in most of the forms shows a tendency to split into two or more ribbon-like strips, allowing the two sides of the blade to fall away from one another at the upper end of the leaf and lie more or less flat.

The polymorphism of phormium is hardly anywhere more strikingly shown than in the degree of rigidity of the leaves. Plants may often be seen growing side by side in a swamp, the leaves of one being absolutely straight and stiff from butt to apex, while in the other the whole upper part of the leaf hangs vertically downwards. Between these extremes all intermediates occur, and this character has been found to be one of the most valuable in distinguishing the various races from one another. The rigidity or otherwise of the leaves, though no doubt influenced by the number of fibre-bundles, is to a large extent dependent on the thickness of the blade, which is another extremely variable quantity.

In nearly all forms the midrib and margins are very conspicuous owing to their striking colours—red, brown, orange, or black being those most often seen. The upper surface of the leaf is smooth and shining, and in colour varies from yellowish-green through bronzy to deep blue-green. As a rule the under-surface is covered with a beautiful and delicate bloom, the amount of which, like the colour of the upper surface, varies in the different races. In those in which it is most abundant it imparts a decided blue sheen to the whole plant.

The leaf becomes considerably thicker at its extreme base or butt, which is variously coloured in the different races of the plant—pink, red, orange, or white.

The Microscopical Structure of the Leaf (Figs. 8 and 9).

On cutting a leaf of phormium across, the section will be seen with the naked eye to consist of alternate bands of green and whitish tissue reaching from surface to surface of the leaf and arranged at right

angles to them. It is from the lighter-coloured of these two kinds of tissue (which correspond to the fine striations on the surface of the leaf) that the fibre of commerce is extracted. Very little idea can be obtained of the fibre and its relation to the surrounding tissues without considerable magnification, but the following description of a transverse section of the leaf as seen under a magnification of about 80 diameters, together with reference to the accompanying illustrations, should make the structure clear.

First (beginning from the top of Fig. 8) comes a single layer of colourless cells (*a*)—the upper epidermis—with their outside walls greatly thickened, the shining upper surfaces of the leaf being due to the reflection of light from these thickened walls. Beneath the epidermis is a layer several cells deep (*b*) of rather thick-walled colourless cells, while immediately below them, again, are seen the alternate bands of green and of colourless tissue already referred to. The green bands (*c*) are rounded above (where they meet the layer of colourless cells), but extend below to the lower side of the leaf, where they are bounded by the lower epidermis (*d*). This green tissue is composed of cells (*e*) with abundant granules containing chlorophyll (the green colouring-matter of plants), its function being the fixation of carbon from the atmosphere.

In the middle of each band of chlorophyll-bearing cells is a large oval or elliptical mass of very big thin-walled empty cells (*f*), the whole group occupying so much space that the green tissue on either side of it is often reduced to a single layer of cells (*g*). The colourless bands vary considerably in number and size, those races of phormium poorest in quantity of fibre having about two hundred in the widest part of the leaf, while others may have as many as four hundred. These colourless bands, or bundles as they are usually called, extend as a rule through nearly the entire thickness of the leaf, and are generally considerably wider towards the upper surface, tapering off towards the lower side. They consist of the following parts: (1.) A surrounding layer of thin-walled cells (*h*). (2.) A compact mass of rather small irregularly rounded, exceedingly thick-walled cells (*i*) with very small openings in their centres, these being the fibre-cells from which the commercial product is obtained. (It may be mentioned here that in the present-day process of fibre-extraction the whole of this tissue is made use of, while the Maori process results in the rupturing of the bundles about half-way down, only their upper parts being used.) (3.) A roughly diamond-shaped mass embedded in the fibre and composed of two triangular-shaped groups of tissue placed base to base. The upper of the two groups, composed of rather large thick-walled cells (*j*), is called the xylem, the lower (*k*) being known as the phloem. The function of the xylem is the conduction of water (containing mineral salts in solution) from the root to the leaves, and that of the phloem the conduction to other parts of the plant of the food materials manufactured in the leaves.

In the chlorophyll-bearing tissue between the bundles are often found much smaller bundles (*l*) similar in structure to the large ones just described, but frequently composed of fibre-cells alone, without any central xylem or phloem. These small bundles are more abundant towards the lower surface of the leaf. The lower epidermis, unlike

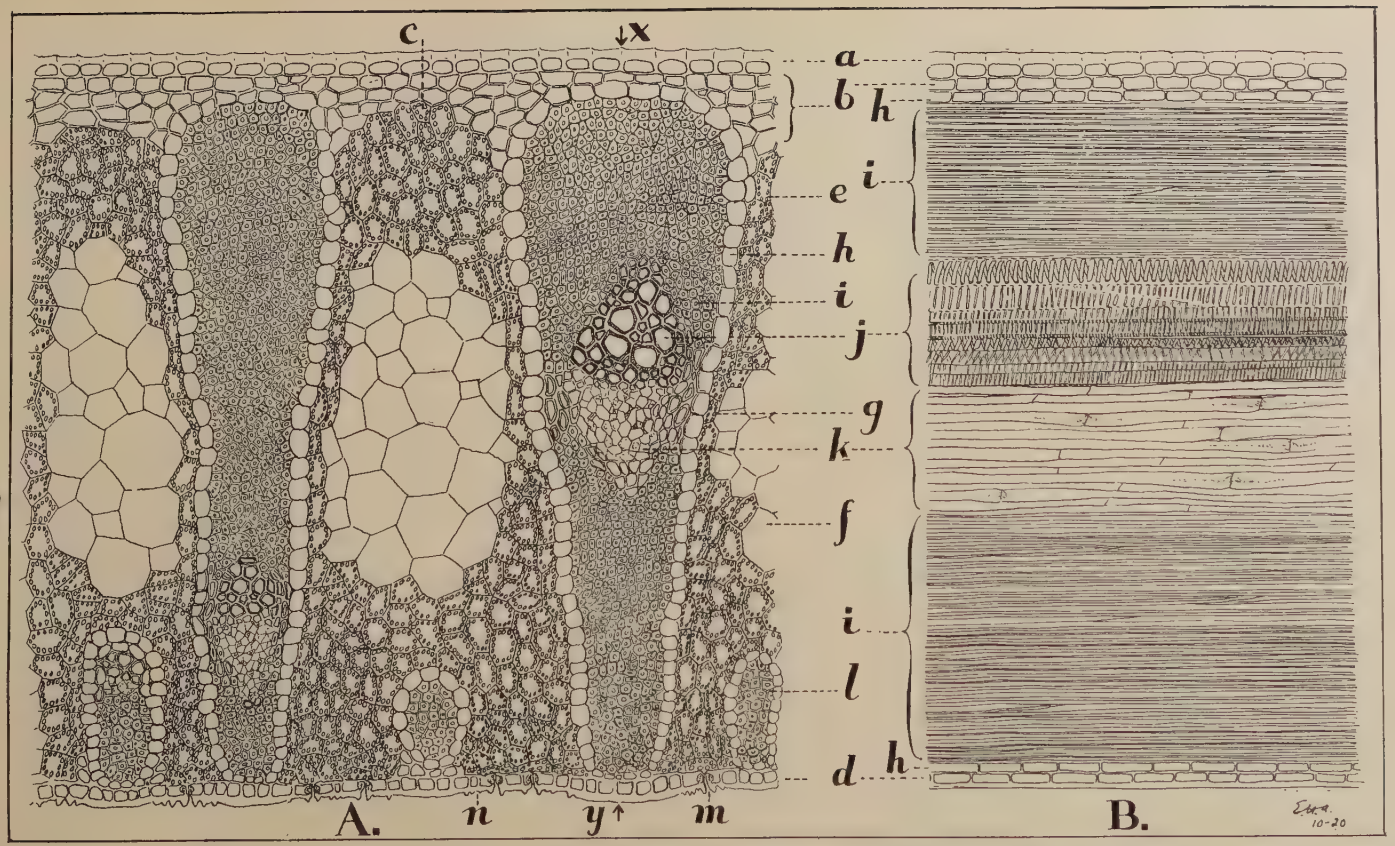


FIG. 8. TRANSVERSE (A) AND LONGITUDINAL (B) SECTION OF LEAF OF PHORMIUM TENAX, × 80.

See text, page 213, for explanation of lettering, which is the same as that used in Fig. 9.

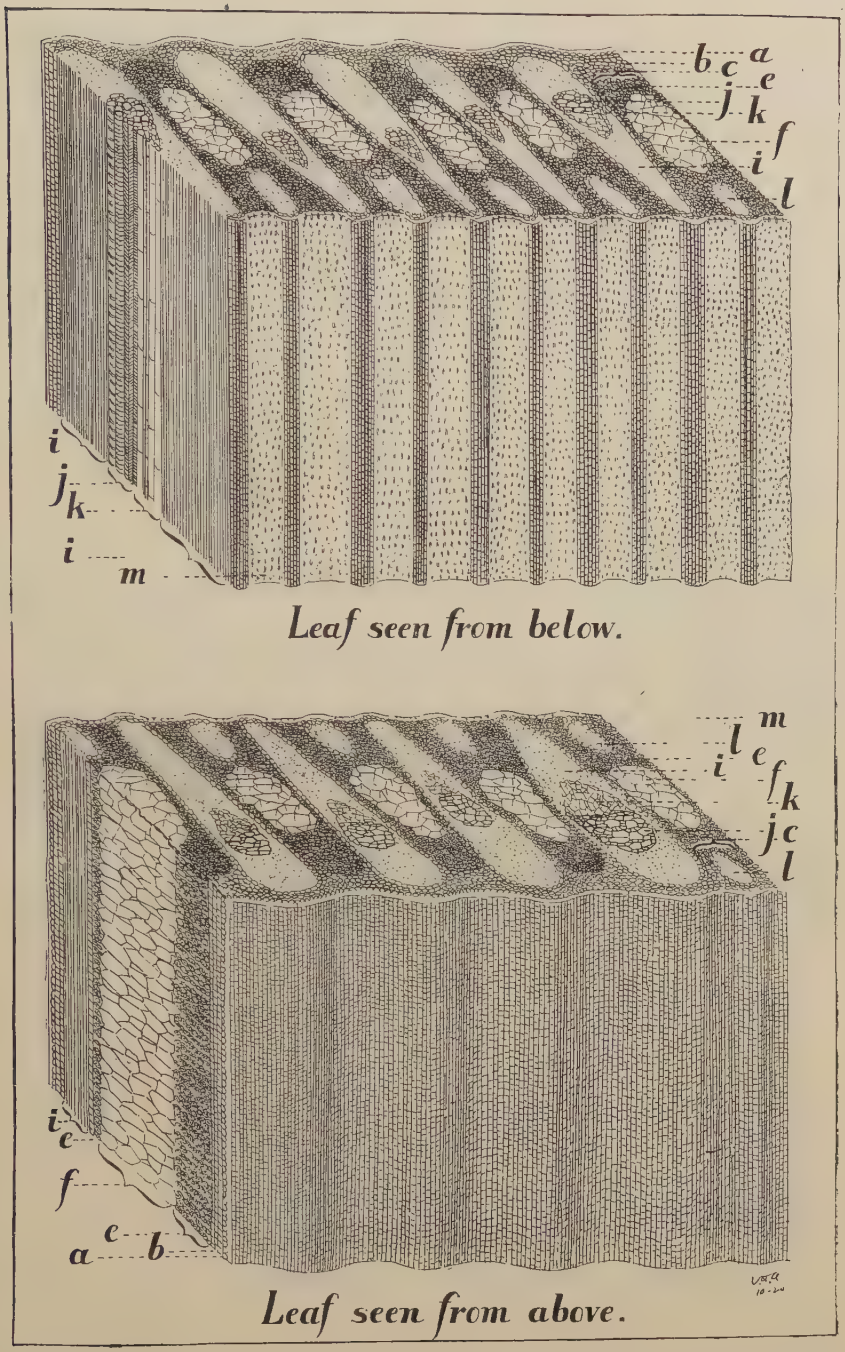


FIG. 9. DIAGRAMMATIC VIEWS OF A SMALL SECTION OF THE LEAF OF PHORMIUM TENAX, × 40, SHOWING DISPOSITION OF FIBRE AND "VEGETATION."

The wedge-shaped dotted areas and the smaller oval ones represent the fibre. See text, page 213, for explanation of lettering, which corresponds with that used in Fig. 8.

the upper, which is uniform over the whole surface, is differentiated in accordance with the nature of the underlying tissues. Opposite the fibre-bundles it is much like the epidermis of the upper surface, chiefly differing in its rather thinner outside wall. Opposite the green tissue of the leaf, however, it is of quite different structure, being pierced by large numbers of stomata or air-pores (*m*), which allow the interchange of gases between the atmosphere and the interior of the leaf. The bloom of the under-surface appears in the section in the form of a series of irregular projections (*n*) of wax, and is only found in that portion of the epidermis in which the stomata occur. The section shown at B, Fig. 8, is made in a vertical direction through a fibre-bundle, and shows the different tissues in longitudinal section, lettered to correspond with those in the transverse section. The fibre is seen in the longitudinal section to consist of elongated cells with pointed ends fitting into one another, the whole forming a compact, strand-like mass.

Fig. 9 shows a portion of the leaf in perspective represented diagrammatically under a lower magnification. The lettering corresponds with that used in Fig. 8.

SEEDLING PLANTS OF PHORMIUM TENAX.

(To be continued.)

Perennial Canary-grass (Phalaris bulbosa).—In a recent communication the Argentine Ministry of Agriculture asks this Department for any information regarding the use of *Phalaris bulbosa* in New Zealand. The special points of inquiry are as to whether it stands grazing, and, if so, the number of cattle it will carry; also regarding its treatment for hay and the machinery necessary for cutting and haymaking, the general idea in Argentina being that it is not possible for a mower to cut the crop. It appears that *Phalaris* has latterly been coming into use in Argentina as a winter forage, but the results are not yet at all conclusive. A note on *Phalaris bulbosa* was published in this *Journal* for July, 1915, the New Zealand experience cited showing that it was an excellent winter grass and withstood heavy stocking.

LUCERNE-CULTURE IN ARGENTINA.

SOME OFFICIAL NOTES FROM BUENOS AIRES.

With a view to obtaining up-to-date first-hand information regarding lucerne and lucerne practice in Argentina—in the animal industry of which country it is such an important factor—the Department recently communicated with the Argentine Ministry of Agriculture, Buenos Aires, requesting particulars on a number of points. A reply has been received from the Division of Agricultural Investigations and Special Studies, written by Mr. Jose M. Scasso, Agricultural Engineer and Specialist in Forage Plants, which makes an interesting addition to the current literature on the subject. The following is a translation from the Spanish of Mr. Scasso's notes, presented under the different headings submitted, the name alfalfa being used for the plant throughout :—

INTRODUCTION OF ALFALFA INTO ARGENTINA.

The information which we have on this point goes to show that alfalfa was introduced into Argentina about the epoch of the conquest of South America by the Spaniards. The date is not known with exactitude, but it is probable that the Jesuits, who evangelized the Indians of this country about the year 1586, were responsible for its introduction and cultivation. Alfalfa adapts itself perfectly to the soil and Argentine climate. There cannot be found a more excellent forage plant in the whole of the Republic, and its cultivation is greater than that of any other crop, the actual area under cultivation amounting to 7,619,000 hectares.*

METHODS OF ESTABLISHMENT.

Preparation of the land: In general, only two cross-ploughings, during the autumn and winter, are usually given in the virgin lands. As the natural fertility is very good the plant develops well without any prior careful preparation of the soil. A common practice—which is followed with no very good results—is the simultaneous sowing of a cereal, such as wheat or oats, with the alfalfa. At the due time this cereal is harvested and the alfalfa pursues its own development. Very few prepare the soil as is advised in this Division's instructions, but those who do so have obtained better results than from the ordinary methods.

Use of inoculated soil and lime: The inoculation of soils as a common practice in Argentina is unknown. Up to the present it has not been found necessary to inoculate the soil for the proper development of the plant; neither have official trials been made on this point, owing to the fact that the climate and physico-chemical composition of the Argentina soils permit of the normal development of alfalfa. With respect to the use of lime, it is a practice that might be widely adopted, seeing that a large proportion of the soils of the cattle-rearing zones of the country is deficient in lime. Notwithstanding this, liming is very little practised.

* A hectare is equal to about 2½ acres.

Rate of seeding: In general, much more seed is used than necessary. The Argentine farmers are accustomed to sow from 28 to 32 kilograms* of seed per hectare, and the practice is widely spread on account of ignorance and habit. The greater number use Argentine seed of a germination of over 85 per cent.

Methods of sowing: Almost the whole of the alfalfa of the country is broadcasted by machinery. In very few cases is seed sown by hand, on account of the fact that each farmer cultivates large areas (generally over 300 hectares) and under these conditions mechanical sowing is much more economical. In other cases machinery is used for sowing in close-drilled rows, a space of 10 centimetres being left between the rows, which is practically the same as if sowing broadcast. It is only exceptionally that wide rows are sown, and then only when such cultivation is necessary to obtain seed.

Cultivation: All that established stands of alfalfa receive is one or two cultivations per year with disk or tine harrows. In many cases after the sowing no cultural care is given, the sown seed being left to its own development. Notwithstanding this, and despite the fact that the land has not been well prepared, it is very rarely that the sowings fail if the seed is of good quality, because alfalfa has adapted itself to the conditions under which it is cultivated.

GRAZING PRACTICE.

The live-stock which utilize alfalfa are in the first place beef-cattle, and then horses, followed sometimes by sheep. The pasturage lasts during the six months of the spring and summer seasons. An alfalfa field is divided into divisions called *potreros*, separated by *alambrados*. These divisions are not used simultaneously, but one after the other, in such a manner that during the time that one or two are being used the rest remain unstocked until the time arrives for their utilization. The duration of the pasture in each division depends, of course, on the number of animals maintained in it, and whether the rainfall during the year is light or heavy. In general, when the atmospheric conditions are favourable the fields maintain from four to five beasts per hectare for twenty days. At this rate of stocking the alfalfa does not suffer. A few of the ruminants pastured on alfalfa are attacked by bloat, this condition occurring when the alfalfa is eaten wet, after rain or heavy dew. Most farmers, however, know how to avoid this trouble.

HAYMAKING AND ENSILAGE.

Haymaking is a common practice with the Argentine farmer or pastoralist. It may be stated that hay was the only stock-food that the *estancieros* used to conserve for winter use. The making of ensilage is, however, now coming into favour, and is becoming widespread on account of the excellent results obtained from it. The stack method is the one most commonly used.

In haymaking the alfalfa is cut with a mower, swept in the evening into *gavillas* with a horse-rake, and turned and scattered the following day, until at the end of two or three days the hay is ready to be hauled to the stack. The haulage is done in large carts, which are able to

* A kilogram is about 2¼ lb.

carry from 2,000 to 3,000 kilograms per trip. The stacks are usually of large dimensions. This is the usual way of preparing the hay, but it generally results in much loss of fodder, seeing that a large quantity of leaves remain scattered over the field, this loss amounting to from 30 to 35 per cent. of the nutritive substance.

In general, the yields of hay are satisfactory. In years of ordinary rainfall four cuttings are made per year of 7,000 kilograms per hectare each cut,* making a total of 28,000 kilograms per hectare. In the environs of the large cities, in the Andine provinces and territories of the south, where they have installations for irrigation purposes, irrigation is much used in the culture of alfalfa, and in these cases naturally the returns are at all times greater, as much as six or eight cuttings per year of 9,000 kilograms per hectare being obtained each cutting—that is to say, 54,000 to 72,000 kilograms per year per hectare.

SEED-PRODUCTION.

The production of alfalfa-seed is one of the principal resources of commercial agriculture in this country. It is calculated that the proportion of Argentine seed utilized annually for the new sowings amounts to 80 per cent., the other 20 per cent. being the product of other countries, principally Italy, France, and the United States. Very good prices are usually obtained for Argentine alfalfa-seed, owing to the large demand for it.

Taking all things into consideration, the production of alfalfa-seed is by no means remarkable. The greater number of farmers make their alfalfa sowings broadcast. During the first two or three years they confine themselves to the production of forage, and in the third year plan to harvest the seed, which is then done each year after one or two cuttings for forage have been made in the spring. Everything depends on the atmospheric conditions and the rains, which are extremely variable from year to year: without seasonable weather nothing can be done. The alfalfa-fields under these ordinary conditions produce as much as 400 kilograms of seed per hectare. In the case of alfalfa under irrigation the production of seed is in the neighbourhood of 600 kilograms per hectare. It has been proved that the existence of colonies of bees in proximity to the alfalfa-fields has resulted in the returns of seed being increased by as much as from 30 to 40 per cent.

USE OF FERTILIZERS.

The use of fertilizers for alfalfa is not practised in Argentina. It is the exception to use manures (in general), and then only in small areas.

DURATION OF STANDS.

There is a notable variation in the duration of alfalfa-fields, according to the regions in which the plant is cultivated. The average duration of the fields in good production is from twelve to fifteen years, but there are zones in which alfalfa-fields of thirty years of age to-day yield good returns, and above all those under irrigation, as in the Territory of the Rio Negro, the Province of St. John, and other parts. In the

* This works out roughly at 2¾ tons per acre per cutting.

provinces of Cordoba (South) and St. Louis, the Territory of La Pampa, and other parts there are alfalfa-fields not under irrigation which have existed for more than twenty-five years, and these still produce abundant crops. This is explained by the fact that the deep-rooted system of the plant utilizes the water that flows many metres deep in the soil. Moreover, there are also in other zones alfalfa-fields which, notwithstanding that they have not received the care they should, have held good for eighteen years and more.

INSECT PESTS AND DISEASES.

The chief plagues of alfalfa in Argentina, in the order named, are two insects—*Colias lesbia*, in its larval state, commonly called *isoca* or the alfalfa-butterfly, and the *Cuscuta* (*C. corymbosa*, *C. suaveolens*, *C. racemosa*, *C. europea*, *C. epithymum*, &c.); and *Rhizoctonia*, commonly called root-rot. It has not been found possible to determine the exact species of *Rhizoctonia*, but it is probably *R. violacea*. In some regions a little damage is done by *Tetranicus telarius*, commonly called "cobweb," on account of the whitish webs similar to those of the spider which cover the infected alfalfa. There is practically no efficacious and economical method of defence against the first-mentioned three pests, as owing to the great extent of the alfalfa-fields any action would be too costly. This is not the case with *T. telarius*, as a light brush harrowing suffices to destroy the webs, and fortunately, owing to the frequent cutting of the plant, the pest is not able to increase.

CONCLUSION.

In a general summing-up it may be said that in Argentina alfalfa is cultivated by the majority in a careless manner. The alfalfa-fields of individual farmers or pastoralists are very large, and the exploitation of alfalfa tends therefore to extensive culture, which is the most rudimentary form of cultivation in the light of modern agricultural practice. Owing to the perfect acclimatization and adaptation of alfalfa to the country, and assuming a successful combat against adverse meteorological conditions and against pests, there is no reason why better cultivation should not result in better returns than are generally obtained. In spite, however, of the unfavourable conditions under which the alfalfa-fields are cultivated, the fact must be recorded, as a result of experience, that the production is generally satisfactory, inasmuch as alfalfa has constituted itself the queen of forage plants in Argentina, both for grazing and for hay.

Lucerne in Dry Weather.—Reporting on the Taranaki and Wanganui districts, Mr. J. W. Deem, Fields Instructor, remarks as follows: In January lucerne was holding back, but the rain near the end of that month sent it along again, and the February cuts were good. This again demonstrates the fact that rain or irrigation is necessary if lucerne is to give heavy cuttings during very dry spells on land that is not alluvial or where the water-table is a long way from the surface.

POISONING OF RABBITS.

SOME ADDITIONAL RECIPES.

H. T. TURNER, District Inspector, Christchurch.

THERE is no doubt that the best results in reducing the rabbit pest are obtained by simultaneous and united action on the part of the landholders. An effort in this direction is generally made during the winter months, but this is not enough, and it is a great mistake to practically cease operations when extermination is, comparatively speaking, within reasonable distance. What is required is that this simultaneous action should be carried on right throughout the year. The past season has been very suitable for breeding, and in many districts rabbits have multiplied to such an extent that prompt and vigorous measures are required for the control of the pest in order to avert serious consequences.

It is fairly generally admitted that the most effective method of reducing the pest so far evolved is that of poisoning, and increasing quantities of poison are being used by settlers each year. In regard to the preparation of the various poisoning specifics, opinions differ as to the comparative advantages of each landholder preparing his own mixture or having it prepared at a central depot. It is certain that the latter method will always be found the cheaper and generally the more reliable and less risky one. Circumstances, however, influence the effectiveness of the best methods, and consequently each settler should adopt the method best suited to his own requirements.

A word of advice to those laying poison may not be out of place. It is well to remember that rabbits are cleanly in their habits and keen to detect any suspicious appearances in their food. It is therefore absolutely necessary that clean, tasty, and attractive baits be laid if the desired result is to be obtained.

Phosphorized pollard properly prepared and laid has proved so efficacious and economical, and its use is now so general, that no comments on it are here called for. It sometimes happens, however, that for various reasons rabbits do not take this poison well, and in these cases it is necessary that some other method should be immediately adopted to deal with the pest. In such case. phosphorized oats, and strychnine and carrots, prepared according to the Department's recipes,* have proved very effective; good results have also been obtained in many instances from the use of Toxa.

LESS-KNOWN RECIPES.

The following recipes, not so generally known, have also been tried by the writer and found very effective, and are well worthy of a trial by occupier. of rabbit-infested country :—

Chaff and Arsenic.—30 lb. of the best chaff, 2 lb. arsenic, 3 lb. sugar, and 1 gallon water. Get a large zinc-lined case and spread about 10 lb.

* For use of strychnine see Bulletin 76.

or 12 lb. of chaff evenly over the bottom of it. Boil the water, and mix the sugar in it. Sprinkle the water over the chaff and shake in the arsenic in pepper-box fashion. Mix thoroughly. Add the remainder of the chaff and again thoroughly mix. It is only necessary to damp the chaff sufficiently to make the arsenic adhere to it. This mixture should be spread at once, as rabbits will not eat poisoned food which has changed its natural appearance through fermentation or any other cause.

Grain and Arsenic.—50 lb. of any grain of good quality, 2 lb. good arsenic, 4 lb. brown sugar, and 1½ gallons water. Put the grain into a tub or boiler, then boil the water and dissolve the sugar in it. Pour this mixture over the grain in the boiler and mix, using a shovel for the purpose. Sift the arsenic on with a dredger, or by such means as will thoroughly disseminate the arsenic through the mass. Keep stirring with shovel until the whole is thoroughly mixed. This mixture should be used three or four hours after mixing, as rabbits will not eat anything sour or musty.

Grain mixed with Arsenic in Water.—50 lb. of any grain of good quality, 2 lb. arsenic, 4 lb. sugar, 2½ gallons water, and 3 lb. flour. Put the grain into a tub or boiler. Boil the water and mix in the sugar and arsenic. Pour the solution over the grain and mix well with a shovel. Sift the flour over the lot and stir well with the shovel, taking care to thoroughly incorporate all the ingredients. This mixture should be used before it has fermented.

Jam and Strychnine.—8 lb. jam (any kind), and 1 oz. powdered strychnine. Mix well, and lay baits in a plough-furrow or scrapes.

Apples and Strychnine.—12 lb. of apples, each apple cut into six or eight pieces according to size. Sprinkle into this 1 oz. powdered strychnine. Lay the baits 10 ft. to 20 ft. apart in a plough-furrow.

USE OF CARBON BISULPHIDE.

Bisulphide of carbon is often used, and is no doubt very effectual. If a large deep burrow be operated upon every hole should be charged. A small bed of cotton-waste or old bagging is generally used, saturated with carbon bisulphide, and put into each hole as far as possible, the opening of the burrow being closed and then rammed. This method is more effectual in summer than in winter, and in hard ground more than in porous, sandy soil. Carbon bisulphide is very deadly in its effects, especially to rabbits. In using and storing it avoid all exposure to heat. Allow no matches or smoking in its vicinity. Take care when using not to inhale more than can be helped, as, though not easily fatal to man, it nevertheless depresses the vital powers.

Fireblight: A Correction.—A slight printer's error occurred in the article on fireblight published in last month's *Journal*. In line 4 of the second paragraph, under the heading of "Hosts," on page 145, the words "on fungus hyphæ" should have been "*no* fungus hyphæ."

SOME BAY OF PLENTY SOILS.

B. C. ASTON, F.I.C., F.N.Z.Inst., Chemist to the Department.

At the request of the local branch of the Farmers' Union at Te Teko the writer, in May, 1919, paid a flying visit to that district and collected a number of samples of soil for analysis. In doing this he was guided by the practice usually followed in such cases, the local officers of the union selecting the areas which they considered typical of the district, and the Chemist then sampling those areas and taking such notes of the surface conditions as seemed to him desirable. In the brief time available there was, of course, no opportunity for conducting anything like a soil survey, and the responsibility for differentiating the main kinds of soil in this district must therefore largely rest with those whose local knowledge entitled them to select the areas to be sampled.

The area traversed contains the Rangitaiki Swamp, which, through the State drainage operations undertaken under the provisions of the Rangitaiki Land Drainage Act, 1910, has been converted into high-class level grazing-country. The rivers of this area, particularly the Tarawera River, have in the past deposited silt or mud which is rich in calcium (lime) compounds, although, unlike that of the Poverty Bay rivers, the silt or mud does not contain the calcium in the form of carbonate of lime, but as silicate or other form soluble in dilute acids. This abundance of calcium compounds in the soils of the Rangitaiki Swamp is reflected in the lime-requirement figures, which in many cases show for a drained swamp remarkably small requirements.

Compared with other soils, these are generally very low in phosphates (available and total), though well supplied with lime, magnesia, and potash. This deficiency in phosphate must, however, be considered in connection with the excess of lime, which is known to render it possible in certain cases to work with a very much smaller amount of phosphate than would otherwise be necessary. It is therefore impossible to draw any definite conclusions as to this type of country until more data are accumulated.

NOTES ON THE SOILS ANALYSED (SEE TABLES).

G 17 and 28.—Samples collected from the Rangitaiki Swamp (R. Reynolds); exact locality not specified.

L 61.—Collected in Larnach's land (late Judge), now down in pasture containing much Indian doob (*Cynodon dactylon*). Original vegetation, manuka (*Leptospermum scoparium* and *L. erecoides*), bracken-fern (*Pteris aquilina* var. *esculenta*), *Mariscus*, and rushes (*Juncus*). Soil has a layer of ash from the Tarawera eruption.

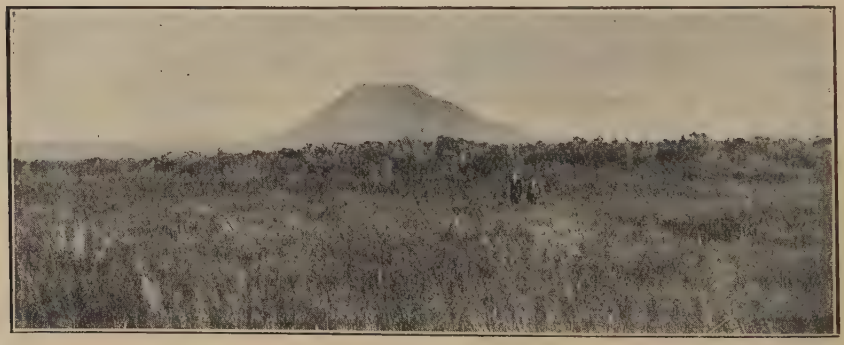
L 63.—Collected from sandy ridge growing manuka, reed (*Gahnia* sp.), and *Cladium* sp. after burning.

L 65.—Collected on the light portion of Crown land south of Hallett's estate, now growing manuka, *Cladium* sp., *Leptocarpus*, &c.

VIEWS IN THE NEIGHBOURHOOD OF THE RANGITAIKI SWAMP, SHOWING MOUNT EDGECUMBE IN THE BACKGROUND.

DRAINED AND CULTIVATED LAND.

THE TARAWERA CHEESE-FACTORY, OTAKIRI.



RUSH AND MANUKA COUNTRY.

[*Photos, B. C. Aston.*

BAY OF PLENTY SOILS.—CHEMICAL ANALYSES. (Results except * are percentages on soil dried at 100° C.)

Laboratory No.	Locality.	Volatile Matter.			Total Nitrogen.	1-per-cent. Citric-acid Extract, Dyer's Method; Hall's Modification ("Available" Plant-food).				Hydrochloric-acid Extract ("Total" Plant-food)				Lime-requirement (Percentage $CaCO_3$).	
		*On Air-drying.	*At 100° C.	On Ignition.		Lime, CaO.	Magnesia, MgO.	Potash, K_2O.	Phosphoric Acid, P_2O_5.	Lime, CaO.	Magnesia, MgO.	Potash, K_2O.	Phosphoric Acid, P_2O_5.	On Air-dried Soil.	On Soil dried at 100° C.
G 17	R. Reynolds, Rangitaiki Swamp	51·1	..	23·70	0·750	..	..	0·030	0·023	1·29	0·63	0·21	0·21	..	..
G 28	R. Reynolds, Rangitaiki Swamp	..	28·10	10·74	0·265	..	..	0·021	0·042	0·57	0·44	0·18	0·17	..	..
L 61	Pasture, Larnach's, Te Teko	7·0	6·62	5·18	0·180	0·112	0·031	0·022	0·010	2·70	1·31	0·13	0·05	0·03	0·03
L 63	Sandy Ridge, Te Teko	7·0	3·64	2·41	0·076	0·070	0·031	0·021	0·006	2·85	1·28	0·11	0·03	0·01	0·01
L 65	Crown land south of Hallett's	17·0	6·90	4·66	0·135	0·085	0·048	0·018	0·004	3·18	1·67	0·10	0·01	0·08	0·09
L 67	Cultivated land in J. D. Smith's and Black Bros.' farms	6·0	6·22	3·87	0·143	0·089	0·033	0·022	0·007	2·78	1·50	0·12	0·05	0·05	0·05
L 69	Returned soldiers' settlement .. .	22·0	15·86	15·43	0·536	0·138	0·068	0·066	0·010	3·06	1·51	0·19	0·10	0·31	0·37
L 71	Terrace on edge of peaty drained swamp, soldiers' settlement	7·0	6·22	4·00	0·146	0·090	0·038	0·022	0·009	1·78	0·85	0·11	0·05	0·04	0·04
L 73	Raupo niggerhead swamp	31·0	30·30	9·41	0·353	0·137	0·073	0·018	0·009	2·09	1·33	0·10	0·07	0·18	0·26
L 75	T. Thomson's farm..	15·0	7·06	6·56	0·244	0·161	0·070	0·027	0·012	3·39	1·76	0·21	0·07	0·09	0·10
L 77	C. F. Reid's farm	26·0	19·80	11·45	0·353	0·159	0·083	0·026	0·007	3·16	1·57	0·25	0·06	0·18	0·22
L 79	Rangitaiki silt, farm of J. A. Wharf	13·0	10·90	8·15	0·258	0·207	0·055	0·046	0·023	1·42	0·91	0·36	0·09	0·11	0·12
L 99	Silty subsoil, Thomson's	14·0	1·66	4·76	0·100	0·106	0·027	0·026	0·014	0·31	0·26	0·20	0·02	0·11	0·11
L 100	Rangitaiki silt, Thomson's	12·0	7·34	12·95	0·369	0·281	0·092	0·035	0·016	0·88	0·75	0·49	0·05	0·18	0·19

MECHANICAL ANALYSES. (Results are percentages on air-dried soil.)

Lab. No.	Description of Soil. (Classification of U.S. Department of Agriculture, modified.)	Analysis of "Fine Earth" passing 2 mm. Sieve.							Stones and Gravel.
		Fine Gravel.	Coarse Sand.	Fine Sand.	Silt.	Fine Silt.	Clay.	Moisture and Loss on Ignition.	
L 61	Coarse sandy soil ..	25·80	27·06	14·71	17·64	3·00	1·50	11·46	18
L 63	,, ..	40·80	40·00	7·00	4·90	1·50	1·70	6·00	15
L 65	,, ..	27·70	39·20	11·20	7·10	2·80	1·20	11·20	25
L 67	,, ..	27·30	39·60	13·40	7·00	2·50	1·20	9·90	9
L 71	,, ..	32·80	38·50	7·60	6·70	3·70	1·50	10·00	10
L 75	,, ..	17·80	41·10	7·60	11·80	8·90	3·00	11·10	11
L 77	,, ..	10·80	32·20	6·70	10·50	7·60	3·30	28·00	15
L 79	Sandy silt	4·50	9·50	7·70	39·60	15·70	5·80	16·00	2
L 99	Fine sandy soil ..	..	..	22·80	60·20	7·20	3·60	6·30	..
L 100	Silt loam	0·70	1·40	1·10	37·60	33·00	7·00	19·40	6

NOTE.—Samples L 69 and L 73 were too peaty for mechanical analysis.

L 67.—Collected on both sides of road in the cultivated land of J. D. Smith and Black Bros. Original vegetation a thicket of manuka in close association, 10 ft. high, mixed with *Pratia angulata*, *Convolvulus sepium*, *Arundo*, *Lomaria capense* var., *Coprosma tenuicaulis*, and *Phormium tenax*.

L 69.—Collected from returned soldiers' settlement, formerly belonging to L. Levin, area opposite cheese-factory (see photograph). Sample taken in uncultivated land at present growing rushes and other similar plants of wet soils.

L 71.—Collected on terrace on edge of peaty drained swamp, in soldiers' settlement, growing *Cladium articulatum*, manuka, cabbage-tree (*Cordyline australis*), *Arundo conspicua*, *Coprosma propinqua*, *Convolvulus sepium*, raupo (*Typha angustifolia*), *Muehlenbeckia complexa*, *Mariscus*, and other marsh-loving vegetation.

L 73.—Collected in raupo niggerhead swamp, containing also *Phormium*, *Isachne*, *Cladium articulatum*, manuka, *Arundo conspicua*, and *Carex* sp.

L 75.—Collected from Block 155, Parish of Matata, from Thomas Thomson's farm. This soil consists of a thin layer of flood-silt from the Rangitaiki River, below this is Tarawera ash 8 in. thick, then 1 in. of humus subsoil, then 9 in. of old swamp, then 1 ft. of black peat.

L 77.—Collected from C. F. Reid's Awaroa Block. Section of drain shows (from bottom) the following: (1) Hard layer of pumice; (2) 4 ft. of brown organic matter; (3) layer of fine silt mixed with peat, 6 ft.; (4) layer of Tarawera ash, 4 in. This block has never been ploughed, but has been surface-sown, and is now growing Yorkshire fog, *Isachne*, *Juncus pallidus*, *J. effusus*, catsear, manuka, plantain, *Gnaphalium* (naturalized), *Gleichenia dicarpe*, *Hydrocotyle asiatica*. The surface is very uneven.

L 79.—Rangitaiki silt, collected on the farm of J. A. Wharf, in rough rush country.

L 99.—Silty subsoil taken below 18 in. from Thomson's farm.

L 100.—Rangitaiki River silt, taken below Tarawera ash on Thomson's farm.

FRIESIAN CALVES AT WERAROA.

TREATMENT OF POTATO SETS.

W. H. TAYLOR, Horticulturist.

It is just as important that potato sets be properly prepared for planting as that they be of a good strain. It is quite common for the seed tubers to be stored in a heap comprising several tons. Such storage might not be harmful if the heap were spread out before the eyes started, but this is often impracticable—for instance, where the sets are intended to plant a considerable acreage and there is not space to store them in any other way. The result frequently is that the eyes start in the heap, and most of the first sprouts are broken off, sometimes intentionally. When eyes are started in this way they quickly become drawn, and where early planting is not practicable—and it rarely is—there is no alternative but to rub them off and rely on second growths. This is a bad beginning, for not only is the first eye best, but its growth and subsequent destruction robs the tuber of starch, and the second growth is inferior.

There can be no doubt that a smaller acreage planted with properly prepared sets gives better returns for the labour involved. It is to be remembered that the same amount of labour and other expenses is involved in planting an acre with bad sets as with good, while the returns are very much less. Some means should be taken to expose the sets to light and air before they show signs of starting. When the breaking eyes are exposed to light and air they form short sturdy sprouts, green in colour. They will remain without making any appreciable growth for a considerable time and retain full vigour until the tubers begin to shrivel. They then begin to lose strength, and should be planted before shrivelling is pronounced. The sets may be stored in any place where they can be protected from frost and heavy rain. Beneath pine-trees is a good place. The tubers should preferably be placed in shallow boxes, packed close together in the boxes, with the rose end up.

SETS FOR EARLY PLANTING.

Recently there has been some correspondence in one of the English horticultural periodicals on this subject. Statements having been made that some growers plant whole sets without cutting them, and that no disbudding is done, correspondents inquire as to the accuracy of this, and, if accurate, why it is done. So far the answer has not been forthcoming.

The method in question has long been practised in New Zealand in places where growers speculate on early crops, and frosts are likely to occur. The common belief is that all the eyes on a set will produce shoots, and that disbudding is necessary to prevent an overplus of shoots, which latter would result in small potatoes. This belief is founded on a fallacy. Potatoes may be roughly divided into two classes—round varieties on which the eyes are nearly all active at the same time, and

kidney-shaped (also some rounds) that have a decided rose end. If the former be planted with all the buds intact a large proportion of them will grow into shoots. Those with a decided rose end behave differently. One, two, or three buds start before the others, and if nothing happens to destroy them they will make the plant; the remaining eyes will remain dormant. If these shoots are cut by frost, injuring only the tops, they may make fresh growth from lower down; in other words, the lower branches may take the lead. This, however, is a check that effects a reduction in the crop, but the latter may still be profitable. A second frost may occur which will entirely destroy the first tops. Other buds, that probably have already broken but not made much headway, then break through and may produce a crop just sufficient to pay costs. This explains why no disbudding is done. The seed tubers are not cut, as that would cause decay, and the second set of buds would not be able to continue growth. A large grower some years ago stated the case to me in this way: "If we have the luck, as we sometimes do, to have no frost we get a good crop which commands high prices. If the plants are cut once the crop will pay. After a second frost they may just about pay what they cost to plant and dig."

HALF-BRED SHEEP AND WOOL.

J. G. COOK, Wool Instructor, Live-stock Division.

HALF-BRED wool is normally in constant good demand by manufacturers because of the popularity of the goods manufactured from it, which have a very pleasing appearance. The term "half-bred" is used regularly in New Zealand for denoting the progeny from any one of the following crosses: (1) Any purebred ram (except a Merino) with a Merino ewe; (2) a Merino ram with any purebred ewe (except a Merino); (3) a half-bred with a half-bred.

The term "half-bred" is used when referring to this class of sheep or its wool because the term is found convenient for making a distinction between this and other crosses. Although the term is employed to indicate a special class of sheep, still a half-bred is a crossbred, because it is the progeny produced by crossing or mating two distinct breeds. When half-bred sheep are referred to, however, it is always understood that they are produced in one of the three ways mentioned above.

There is no wool which has such a wide range of spinning-quality as the half-bred. The writer has seen it in some flocks where it would only give 46's, and then in some of the finest-woolled flocks go up to 58's quality. It is owing to this wide range of spinning, also to the sheep themselves varying so much, that the term "half-bred" is useful when referring to the sheep or its wool, for until the type is set it cannot well be called anything else. When once a type is set it has to be recognized as a distinct breed and a name bestowed upon it. The wool, of course, carries the same name.

In order to obtain a dual-purpose sheep—a good producer of both mutton and wool—the following longwool rams are crossed with Merino

ewes: Lincoln, English Leicester, Romney Marsh, Wensleydale, and Border Leicester. The progeny of these matings answer very well the purposes required. The wool is a good shafty combing-wool in each case, throwing towards the ram for both length and tip, but the fibre is very much finer, with more undulations throughout its length, thus showing the Merino strain.

Now will be pointed out the reason of such a wide range of spinning-quality in wool which comes under the term of half-bred. Lincoln wool is the coarsest and longest that is grown in the Dominion; therefore the wool grown on the progeny produced by the mating of a Lincoln ram with a Merino ewe is the coarsest half-bred wool we have. The writer has seen it down to 46's quality, when it could quite safely have been passed as fine crossbred. The English Leicester and the Wensleydales are next to the Lincoln for coarseness of wool; therefore when mated with the Merino ewe the wool grown by the progeny is finer in the fibre, with a few more undulations, which give it a slightly higher spinning-count than the Lincoln-Merino cross. When the Romney and Border Leicester are mated with the Merino ewe the wool grown by the progeny shows very little difference one with the other, both having the same spinning-quality.

We now come to the progeny by mating the Merino ram with any of the following longwool ewes: Lincoln, English Leicester, Wensleydale, Romney, and Border Leicester. We find that the wool grown by the progeny has a good length of staple well suited for combing purposes, throwing towards the ewe in that respect. It is in the tip, in the fineness of the fibre and undulations throughout its length, also in weight, that it throws to the Merino ram. The wool is pleasant to deal with, being what is called a "good handling-wool."

Then there are the different Down breeds, also the Ryeland. Of course, none of these are used as extensively as any of those previously mentioned, and of the Downs it is generally the Shropshire ram which is mated with the Merino ewe. The wool grown by the progeny from this mating is sometimes long enough to be classed as a combing-wool, but when too short it has to be classed as a clothing-wool. The same remark applies to the wool grown by the progeny from crossing the Suffolk with the Merino or the Southdown with the Merino.

So far the writer has dealt with wools grown by progeny produced by thirteen different crossings or matings. These are as follows, the ram being mentioned first in each case: Lincoln-Merino, English Leicester-Merino, Wensleydale-Merino, Romney Marsh - Merino, Border Leicester-Merino, Merino-Lincoln, Merino - English Leicester, Merino-Wensleydale, Merino - Border Leicester, Merino - Romney Marsh, Shropshire-Merino, Suffolk Down - Merino, Southdown-Merino.

A better idea will now be had why there is such a wide variation in the spinning-quality of the wool which comes under the term of half-bred.

Certificates in Beekeeping.—Since the classes in beekeeping were instituted, in 1915, at the Ruakura Farm of Instruction a total of sixty-three persons have passed the examination held at the end of each season, and gained the Department's certificate in beekeeping.

THE BUDDING OF CITRUS-TREES.

EXPERIENCE AT TAURANGA HORTICULTURAL STATION.

J. H. DAVIDSON, Manager, Tauranga Horticultural Station.

THE importance to the citrus-fruit grower of starting with well-formed, vigorous young trees cannot be overestimated. Experience has shown that years may be wasted in attempts to establish trees of a poor description. The problem of citrus stocks is a large one; finality has not been reached in any citrus-growing country. So far as concerns New Zealand, where the citrus-fruit industry is yet in its infancy, a great amount of work and careful observation will have to be undertaken in experimenting with the various stocks. In the experimental work so far carried out at the Tauranga Horticultural Station a considerable degree of success has been achieved. Young trees of good type and vigour have been raised, but a few years' growth in the orchard is required to fully prove their value. A feature of the work has been a demonstration of the effect of working stocks of different dimensions, and some particulars of these experiments are given in the following notes. Most authorities advise that stocks are ready for working when the thickness of a lead-pencil, but experience at Tauranga does not support that recommendation.

Granted that it is desirable that a tree shall have a clean straight stem of at least 2 ft. in height, with a well-balanced head, the question then is, how can such a tree best be produced?

A stock that calipers $\frac{3}{8}$ in. is budded, say, on 10th November, and fourteen days later the stock is cut back to within 2 in. of the bud. In two weeks' time the bud will commence to grow, and continue until it reaches a height of 8 in. or 9 in., when it will stop for a period, and the growth will harden up. A month or so later a second growth will commence, but this will not be a continuation of the lead—it will branch out and form a head. The result is a bush with a stem 6 in. in height. The subsequent growth will be from the branches already formed. As it is desirable that the tree shall have a higher stem than 6 in., the bulk of the growth made during the next two seasons will have to be carefully pruned away, resulting in a scarred stem, not very straight, and with anything but a well-balanced top.

On the other hand, a $\frac{3}{4}$ in. stock is budded and headed back on the same dates respectively. The bud commences to grow and will continue growing vigorously until it reaches a height of 28 in. or 30 in., when it will stop. It can then be pinched back to strengthen it. The next growth will be the foundation of a well-balanced head, and six months later there is a tree ready to be set out in the orchard if autumn planting is desired.

Thus the $\frac{3}{8}$ in. stock two years after budding will be an inferior tree to the $\frac{3}{4}$ in. stock at nine months from the time of budding. These are the results obtained at the Tauranga Station, although possibly they may not apply to other countries or even to other parts of the Auckland Province.

The following is from Professor Coit's book entitled "Citrus Fruits":—

"Budding stock handled as described, and properly cultivated and irrigated, should be large enough to bud at the end of one or two years—usually eighteen months. It is false economy to bud seedlings which are too small, the ideal size being $\frac{3}{16}$ in. to $\frac{7}{16}$ in. in diameter 3 in. from the ground" (page 92). "Nursery trees should be allowed to grow 3 ft. tall and then headed back to 27 in. or 30 in. This will ensure the main branches being set upon stronger wood than if the terminal bud

A COMPARISON IN CITRUS BUDDING.

On left, Crisp's lemon on lime stock of $\frac{1}{2}$ in. diameter, budded 15th March, 1920; growth made to 20th December about 15 in. On right, Crisp's lemon on lime stock of $\frac{3}{4}$ in. diameter, budded on same date, but with about 30 in. of strong growth to 20th December.

was pinched as soon as it reached the desired height" (page 100). "One or two years are required to grow a marketable tree. We find, therefore, that a total of from four to six years is required from planting the seed to setting the trees in orchard form" (page 102).

It will be noted that Coit says that nursery trees should be allowed to grow 3 ft. tall and then headed back to 27 in. or 30 in. This is sound advice, but there would be no hope of getting that growth at Tauranga on stocks of $\frac{3}{16}$ in. to $\frac{7}{16}$ in. diameter; they would not make half of it.

If a stock budded at eighteen months makes a first growth of 3 ft. a good marketable tree will be the result at the end of a year, or two years and a half from the planting of the seed. According to Coit, from four to six years are required from the planting of the seed to

A CONTRAST IN YOUNG LEMON-TREES.

On left, average specimen of lemon-tree supplied commercially for planting. On right, a lemon-tree (Eureka on lime stock) sixteen months from the bud, grown at the Tauranga Horticultural Station.

setting out the trees in the orchard. It is only four years last August since the first seedlings were started at the Tauranga Station, and there are at time of writing trees in the stock-testing area heavily laden with young fruit (which, of course, will not be allowed to remain).

In many instances the class of citrus-tree made available by the trade for planting is very inferior indeed, as will be seen from one of the accompanying photos.

With regard to the best time to bud stocks, there are arguments in favour of both summer and autumn budding. Personally, the writer prefers November and December. If the stocks are right the trees are ready for setting out the following spring. A point in favour of autumn budding is that the buds come away with the first flow of sap in the spring, and are therefore stronger than summer buds. While this is true, it should be remembered that the trees have to remain in the nursery for seventeen months after working till they can be disposed of, as against nine months for summer buds. Moreover, for some reason or other quite a number of dormant buds fail to start into growth when the stocks are headed back in the spring, while our average take for summer budding is 98 per cent.

In my opinion the earliest date for the active bud is about 10th November, according to the season, and the latest during the second week in January; the bud is liable to freeze out if later. The best time to bud is as soon as the bark will slip; by budding in November it has a long season of growth. As regards the dormant bud, the best time is from 10th to 30th March, or later if the bark will lift and the buds are right.

It is recognized that the young growth on a worked stock must be kept upright. At Tauranga, where stakes are easily procured, these are used. In commercial establishments, however, the provision of stakes is usually out of the question. In such cases a 6 in. stub would be left on the stock to which to tie the leader, in place of 2 in. as practised at this station.

CONTROL OF POWDERY MILDEW ON APPLE-TREES.

EXPERIMENTS AT PAPANUI EXPERIMENTAL ORCHARD.

W. K. DALLAS, Orchard Instructor, Christchurch.

THIS season a series of experiments in the control of powdery mildew (*Podosphaera leucotricha*) was carried out at the Papanui Experimental Orchard, Christchurch. The disease was very prevalent throughout the whole of the Canterbury District.

The spraying-compounds experimented with were — (*a*) Sulphur atoms; (*b*) iron sulphide; (*c*) lime-sulphur with naphthalene; (*d*) atomic sulphur. The sprays were applied by means of a knapsack pump. Arsenate sprays were applied separately, and not within three days of lime-sulphur or other summer spray. Advantage was taken in general of dull days to apply the sprays.

The variety experimented upon was Rome Beauty apple—eleven trees. Mildew-infected twigs were pruned off all the trees when in bloom, with the exception of one which was left unpruned.

Plot 1.—Sulphur atoms, 1 lb. in 9 gallons, applied at open-cluster and fruit-set periods, and two further applications of same strength at an interval of about one month. Three trees.

Before spraying many twigs were badly affected with powdery mildew, this also being the condition of the trees in the other plots. When examined on 5th November mildew infection was fairly prevalent. Infected twigs were pruned off and destroyed. On 10th December and again on 7th March thirty new season's shoots were observed to be affected, but on the whole these trees were very free from powdery mildew. This compound gave best results. The trees made good growth, and the foliage was of a rich dark-green colour.

Plot 2.—Iron sulphide, 1½ lb. in 10 gallons, applied at open-cluster and fruit-set periods, and two further applications of the same strength at an interval of about one month. Two trees.

On 5th November, when examined, mildew was prevalent. On one of the trees the infected twigs were pruned off and destroyed, while the other tree was left unpruned. On 10th December the pruned tree carried eleven affected twigs and the unpruned fifteen, and on 7th March the affected twigs numbered nine and twenty-one respectively. The experiment clearly showed that the pruning-off of infected twigs is a factor in controlling this disease. The foliage was not nearly so bright and healthy-looking as that of the trees sprayed with the other compounds.

Plot 3.—Lime-sulphur with naphthalene, 1 in 10, applied at bud-movement, 1 in 30 at open cluster; 1 in 100 at fruit-set; and two further applications at the weaker strength at an interval of about a month. Three trees.

When examined on 24th October powdery mildew was prevalent to such an extent that it was clearly evident that the bud-movement spray had very little if any effect upon the disease. On 5th November, after the 1–30 application, mildew-affected leaves were observed to be dry, and crumbled when pressed between the fingers. Infected twigs were pruned off and destroyed when the trees were in bloom. On 10th December it was recorded that there were sixty-five new season's shoots affected, and at the final examination, on 7th March, there were sixty-eight. This compound gave better results than the atomic sulphur. The trees made good growth.

Plot 4.—Atomic sulphur, 10 lb. in 100 gallons, applied at open cluster; 8 lb. in 100 gallons at fruit-set; and two further applications at the weaker strength at an interval of about one month. Three trees.

When examined on 5th November mildew infection was prevalent. Infected twigs were cut off and destroyed when the trees were in bloom. When examined on 10th December forty-nine shoots were recorded as being infected. At the final examination, on 7th March, there were 101 mildew-infected twigs. This is recorded as the worst mildew-infected plot in the experiments.

CONCLUSIONS.

Of the compounds experimented with, sulphur atoms gave the best results. The trees sprayed with this spray were freer of mildew, and the foliage was brighter and of a richer green, than that of the trees

sprayed with the other compounds. Iron sulphide was also effective, but the foliage lacked the brightness and the greenness of the trees sprayed with sulphur atoms. There was very little to choose between lime-sulphur with naphthalene and atomic sulphur, but the first-named was rather more effective than the latter.

There was no burning of the foliage or russeting of the fruit by any of the compounds. It was demonstrated that the pruning-off and destroying of infected twigs is an important factor in the control of powdery mildew.

ENSILAGE IN THE WAKATIPU DISTRICT.

CONTROL OF CALIFORNIAN THISTLE.

W. ALEXANDER, Fields Instructor, Invercargill.

Two years ago Messrs. Macadam Bros. acquired in the Frankton Valley a block of 300 acres of fertile land, which was then part of Kawarau Falls Station. The two most persistent enemies of the settler in the Lakes District are rabbits and Californian thistles, and the Frankton Valley was no exception to the rule. Some definite idea of the hold that the Californian thistle had on Messrs. Macadam's farm may be obtained by reference to the accompanying photograph (Fig. 1), taken on starting cultural operations. The thistles were so dense that the horses drawing the roller had to be protected with sheep-skins, and in places the whole team had to be yoked to the roller outrigger-fashion.

The system adopted to deal with the thistles was first to roll them flat with a heavy Cambridge roller, then plough deeply with a swamp-plough, using the chain to drag the thistles under. The land was then left to lie fallow during the winter, during which time the thistles rotted into valuable green manure. In the spring the plough was again started, and the land was ploughed altogether four times before being sown out in a special ensilage crop. This sowing was completed during the third week in October last, on 28 acres of land, the seeding per acre being as follows: Tares, 2 bushels; Garton oats, ¾ bushel; broad beans, 1 bushel. No fertilizer was used, as none was necessary.

The ploughing-in of some 10 tons per acre of green manure in the form of thistles, followed up by intense cultivation, provided an excellent, deep seed-bed. A very good germination resulted, with a decided check to the thistles. There were still many thistles in the crop, but they did not represent 1 per cent. of what had been there before. The crop continued to do well, and on 27th January the mower was started, a few acres of the crop being intended for ensilage.

The balance of fodders comprising this crop was not as well maintained as could be desired, but that is perhaps not a disadvantage. It is evident that 2 bushels of tares to ¾ bushel of oats will give a decided preponderance of tares, while the bushel of beans in the mixture might well have been left out, as they were scarcely seen. The faster and more vigorously growing tares simply smothered the beans out of existence; the few bean-stalks which were in evidence at all were growing round the outside of the crop.

Fig. 2 shows very clearly the nature of the crop at time of cutting, also the heavy growth of tares against the smaller proportion of oats.

BREAKING IN LAND FROM CALIFORNIAN THISTLE ON MESSRS. MACADAM BROS.' FARM, FRANKTON VALLEY.

THE ENSILAGE CROP WHICH FOLLOWED, SHOWING DENSITY AND PROPORTION OF TARES TO OATS.

THE ENSILAGE STACK IN PROCESS OF ERECTION.

The making of a portion of the crop into ensilage was a matter of great local interest, as this valuable winter fodder is not at all well known in the district. The ground-measurement of the stack is 16 ft. by 18 ft., and it was built to a height of 14 ft. The contents were estimated at 70 tons, there being approximately 5 acres of crop of an average weight of 14 tons per acre. A stacker and sweeps were used, and gave every satisfaction when allowance was made for having to lift the green crop instead of hay.

The making of ensilage really marks a new departure in providing winter fodder as far as the Wakatipu district is concerned. Turnip-growing is a somewhat precarious business in Central Otago, whilst ensilage is certain, and in a district where the winters are hard and winter feeding is essential this is an important point. The increase in carrying-capacity as a result of ensilage-making should also make the practice a profitable one quite apart from the advantages which accrue from the eradication of Californian thistle and the growing of leguminous crops. The Wakatipu district, like other parts of Central Otago, is very suitable for the production of leguminous crops.

Blowing of Stock on Clover or Lucerne.—The condition known as "hoven," or "blowing," may be caused by any feed that may produce indigestion, gases forming as the result of fermentation. This condition most usually follows the eating of lush pasture rich in clover, or of lucerne, either too greedily or in too large quantities. When eaten in this manner, or after rain or heavy dews, the processes of digestion are imperfectly performed, with the result mentioned. It is therefore good practice to turn stock into lucerne for short periods only, and not till the wind or sun has dried it if rain has fallen. Preferably lucerne should be fed cut or as hay. If cut, it should be fed shortly afterwards and not kept in heaps to ferment and heat. In cases where treatment is necessary the animal should be given a sharp walk for a few minutes, and a wooden gag put in the mouth. This makes the animal swallow a large quantity of saliva, and so allows exit of gas through the œsophagus (gullet). In extreme cases a trocar and canula may have to be used to relieve the tension, and a dose of oil with 1 oz. of turpentine administered.—*Live-stock Division.*

Draught Horses' Shoulders.—The secret in keeping the shoulders of draught horses whole and sound is in having properly fitting collars, and horses in good condition. Broken shoulders are in the majority of cases due to the collar being too big. In fitting a collar care should be taken that the length is sufficient, but the sides must fit close to the neck. The padding and shoulders should be kept clean and free from matted hair and dandruff. No medicinal agent will prevent the shoulders from breaking if the collar fits badly. However, both methylated spirits of wine and solution of alum in water have a tendency to harden the skin.—*Live-stock Division.*

LUCERNE IN THE UPPER CLARENCE VALLEY.

SOME interesting notes and photographs are supplied by Mr. J. G. Scott and Mr. F. J. Sisson, Inspectors of Stock, in regard to the growing of lucerne and red clover, and general revegetating, on the Bluff Run, Kekerangu, Upper Clarence Valley, in the Marlborough back country. Eighteen months ago this run was badly infested and eaten bare by rabbits, but the pest has since been got well under control.

FIG. 1. LUCERNE STAND ON BLUFF RUN, KEKERANGU, UPPER CLARENCE VALLEY.

Mr. Scott writes: "The Bluff Station affords a striking instance of formerly rabbit depleted country getting back into vegetation. Large areas of such country are now carrying a heavy growth of thistles and other weeds. These portions, in fact, appear to be crying out for seed, and the lessees of the Bluff have already purchased cocksfoot for that purpose. The lessees also propose to go in largely for lucerne-growing. Already they have about 20 acres in that crop. This part of the Clarence Valley appears to be very suitable in soil and climate for the growing of lucerne."

Mr. Sisson's notes comprise the following: "While at the Bluff, Kekerangu, on 25th February last with Inspector Scott I took several snapshots of lucerne and red-clover crops growing on this property, together with adjoining paddocks, with a view of showing what this land is capable of now that the rabbit pest is under control. The first view (Fig. 1) shows a very fine field of lucerne. The land was ploughed

once, 5 in. deep, in December last, then harrowed once, and 15 lb. of second-class seed broadcasted on 3rd January, followed by rolling. Nothing further was done to it, nor was manure of any kind used. This land is over 1,600 ft. above sea-level and is fifty miles inland. The soil is medium light, with loose subsoil of good quality for the growing of lucerne. Nothing had been done to the land for fifteen years. There is only a plain wire fence round the field, and nothing to protect the crop from rabbits, which have not attacked it, being now few and far between. The second view (Fig. 2) shows lucerne and red clover doing well together (on right of fence). This mixture was broadcasted (surface-sown) and then harrowed, nothing further being done by way

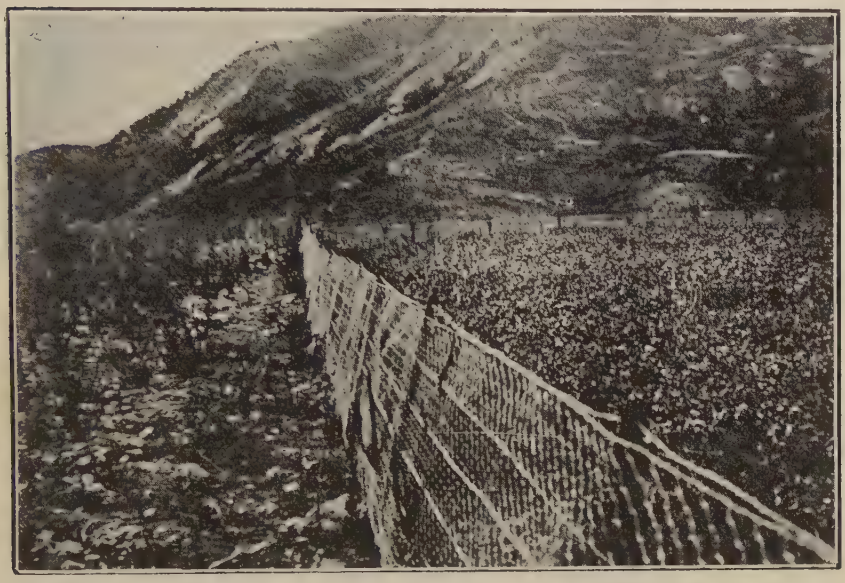


FIG. 2. PART OF FIELD OF LUCERNE AND RED CLOVER (RIGHT OF FENCE) ON BLUFF RUN.

To left is seen unsown depleted ground.

of cultivation. Outside the fence (to the left) is seen depleted unsown ground. It is the present occupiers' intention to break up as much land as possible, with a view of sowing lucerne on all suitable flats early next spring; also to sow a large quantity of cocksfoot on the hills. The stock at present grazing on this run are chiefly two-tooth ewes and young cattle, which at the time of our visit were all fat."

Noxious Weeds.—The Eketahuna County Council has declared foxglove to be a noxious weed in the district under its jurisdiction.

WORK FOR THE COMING MONTH.

THE ORCHARD.

EXPORT OF FRUIT.

Owing to the general shortage of refrigerated shipping-space, combined with the recent labour troubles on the waterfront, no boat was available for the carriage of fruit during the month of March. This, although unavoidable, is very much to be regretted, for as a consequence not only were a large number of Cox's and similar early varieties shut out, but a large quantity of the later sorts, such as Jonathan, had to be placed in cool storage for the purpose of holding them within the stage of maturity suitable for shipment.

The "Athenic" is loading fruit at the time of writing. When completed, this consignment will number some 30,000 cases of apples, and from 5,000 to 6,000 half-cases of pears. The latter will be shipped under special conditions, being allotted a separate small cool chamber. The fruit comprising this shipment is so far coming to hand satisfactorily and in good order, and the advantage of strengthening the cases by means of wiring is again being demonstrated, proving that the little extra labour and expense entailed in this direction will be well repaid.

A further shipment of fruit has been arranged for, and the boat is timed to leave Wellington before the end of this month. It is possible that a small shipment will also be made early next month.

—*J. A. Campbell, Assistant Director of the Horticulture Division.*

AUCKLAND.

The fruit season, in so far as the harvesting of the crop is concerned, may be considered at an end, and thus ample opportunity is afforded orchardists during this month to carry out an annual cleaning-up of the orchard, sheds, and machinery, and to trim shelter-belts, &c. In this respect the first attention should be given to a thorough searching inspection of all orchard-trees for signs of infection by fireblight, and if such is detected it should be immediately cut out, making the cut well below the lowest point of visible infection on any individual branch and destroying all infected parts by burning. The wound should then be painted over with disinfectant as a prevention against further infection, and pruning-instruments should be sterilized after each cut is made.

The weather at this period of the year is usually very favourable for the work of preparing the ground for planting operations—the early autumn rains rendering the soil in a fit state for the most successful carrying-out of the work. Intending planters are advised to place their orders for new trees as early as possible, and are reminded of the fruit-tree grading regulations, which came into force recently.

An examination of budded trees should be made from time to time, and if tied they should be loosened or removed as circumstances demand.

Those citrus-growers who have not yet applied the red-oil spray for control of scale insects may do so now with advantage, provided no frosts—which cause a general weakening of the trees—have been experienced. If frosts have been experienced this application is better deferred until the rise of sap in the early spring, when oil, 1–40, may be used.

Owing to the exceptional amount of frosty weather experienced in this district during the last three seasons, and the possibility of similar conditions during the coming planting season, intending planters of citrus-trees are advised to defer all planting-out until early spring. Undoubtedly citrus-trees do better under favourable conditions if they are planted in the early autumn and obtain the benefit of any warm rains at that season, but their liability to frost injury makes

such a practice inadvisable under present climatic conditions, and all trees received from the nursery before spring should be carefully heeled in and covered from frost. —*J. W. Collard, Orchard Instructor, Auckland.*

HAWKE'S BAY.

With the last of the season's fruit crop harvested early opportunity should be taken to clear up the orchard. All waste fruit should be cleared up, props, spare cases, &c., stowed away, sheds cleaned out, spray plant overhauled, and refuse removed from drains.

Early ploughing will be more than ever necessary this year to open up the soil and allow easy penetration of moisture to the parched subsoil. Land intended for orchard extension or new planting should be worked thoroughly. Plough deep, and use a subsoil-plough where convenient, as all classes of soil are improved by such treatment.

As the various stone-fruit trees attain suitable condition a start may be made with pruning. Providing the trees are in suitable condition an early start is advisable and tends to ease the work later on.

Pest and disease control: Stone-fruit trees—The fall of the leaf has proved a good time to apply bordeaux, 8–6–40, for such diseases as die-back, shot-hole, and rust, as many spores are killed which would otherwise do considerable damage between now and the spring application of bordeaux. Trees which are attacked by San Jose scale may be sprayed to better advantage with lime-sulphur, 1–15. Apples—Where aphis is present oil should be applied at leaf-fall at a strength of 1–25. Last season's results indicate that this autumn application is necessary where later sprayings are to be delayed until well on towards bud-movement. Pears—Trees on which blister-mite or San Jose scale have been noticed during the season should be sprayed with lime-sulphur, 1–15, just prior to leaf-fall. —*W. H. Rice, Orchard Instructor, Hastings.*

NELSON.

If there is a quiet period at all in the orchard year it is during the months of May and June. Spraying, harvesting, and export packing are over, and the planter, like his trees, to some extent can take a rest. It affords the rare opportunity of doing odd jobs and any building that may be decided on. It is the right season for trimming hedges and cleaning up drains, and very important work this is too. As stated before in these notes, maintaining the right water-content in Nelson soils is the foundation of success. See that your foundation is right.

Planting is also a subject requiring attention. Fruit-trees, plantation-trees, or hedge-plants may be required. Apart from the right varieties, the main factors in attaining good results are to secure good plants and place them in suitable land that is well prepared. With regard to plantation-trees, preparation may mean only protection from fire and stock, but with hedge-plants and fruit-trees the preparation cannot be too thorough. The objects aimed at in such preparation are to turn in and rot all present herbage, clean the soil from all bad weeds, and give it deep and thorough cultivation; once the planting is completed opportunities for doing this work are rare and difficult. It is no exaggeration to say that 50 per cent. of our orchard difficulties are due to indifferent-quality trees placed in poorly prepared ground.

It is to be hoped that by this time all cull fruit has been fed to stock, and all sound lines are properly stored. The fruit-store will need careful supervision; give ample ventilation during the colder nights.

—*W. C. Hyde, Orchard Instructor, Nelson.*

MOTUEKA.

By the time these notes appear the fruit crop will be practically all harvested. Fruit kept in storage should be watched for condition and marketed accordingly. Pears in particular will need watching closely, as, with many varieties, deterioration commences at the core, whilst outwardly they appear perfectly sound until handled and cut.

Where new trees are required for replacing unprofitable varieties or extension of areas, orders should be placed early with a reliable nursery. Nurserymen are now required to grade their fruit-trees, so the grade required, either "Special,"

"Commercial," or "Nursery," should be clearly stated by the orchardist when ordering.

Drains should be attended to before the wet season commences, blocked-up drains being put in working-order and new drains established where necessary. Good drainage is very important, because nothing tends to reduce the vitality of a tree more than "wet feet." The results of this are not noticeable until the spring growth commences, and then, after apparently flourishing for a short period while using up the food stored within the tree, die-back sets in through the root-system not being able to carry on its functions and supply further nourishment. In addition to the ordinary established drains, it will be found advantageous to open up a few furrows with the plough to take away the surplus water. Where this is done avoid leaving the banked-up furrow on either side; it should be broken, otherwise it tends to hold the water back.

The orchard should be ploughed as early as possible after the crop is gathered. The soil will benefit greatly by being exposed in rough furrows to the winter frosts. As previously advised, plough with the lay of the land where possible, and avoid ploughing across the slopes; this practice will give much better drainage facilities, and prevent the accumulation of surface waters, which interferes with the capillarity of the soil. —*W. T. Goodwin, Orchard Instructor, Motueka.*

CANTERBURY.

Pests and diseases: For woolly aphis, when the fruit has been picked, good results can be obtained by spraying the trees with emulsified red oil, 1–60, or with Blackleaf 40, 1–800. Stone-fruit growers should gather and destroy all mummified fruits, and thus prevent a carry-over of disease through this means. Trees affected with peach leaf-curl, brown-rot, shot-hole fungus, pocket-plum, and rust should be sprayed thoroughly with bordeaux, 6–4–50, when the leaves are beginning to fall.

Storing the crop: When these notes appear the harvesting of the crop will be practically finished for this season. Growers who stored mid-season fruit in sheds should examine it at frequent intervals and market without delay immediately it begins to show signs of going off. Stored fruit should always be repacked before being placed on the market.

Drainage: The drainage of heavy retentive soils should not be neglected. Tile drains, though more expensive, are the most permanent type of drain and give the best results. The diameter of tiles for main drains should be 4 in. Existing open drains should be cleaned out and the outlets to pipe drains cleared so as to let the water pass freely away. Drainage permits of the land being worked earlier in the spring, makes it easier to work, and prevents souring of the soil. The soil is then much more congenial for the roots of the trees.

Preparations for planting: If planting is intended for this season the land, if not already cultivated, should now be thoroughly worked and made ready. Good deep working is what is required, and no effort should be spared to put the land in good order. After the trees are planted the land cannot be cultivated to the same extent as now.

Orchard sanitation: The period between the completion of picking fruit and the commencement of winter work should be devoted to a thorough clean-up of the orchard. Previous years' prunings which have been left lying about the orchard should be destroyed at once. Orchard boxes should be repaired and stacked away in a dry place for next season. Gather up and stack away in some convenient place the props used in supporting this season's fruit-laden branches.

Consider carefully your spraying programme for the coming season for the control of pests and diseases in the orchard; the Orchard Instructor will be pleased to assist you in this matter. All fruitgrowers are cordially invited to visit the Department's Experimental Orchard, 241 Harewood Road, Papanui, Christchurch, for the purpose of seeing what is being done there.

—*W. K. Dallas, Orchard Instructor, Christchurch.*

OTAGO.

Stone-fruits will now be finished, with the exception of a few late peaches, and growers will be turning their attention to pruning those trees now losing their foliage. It is good practice to get well ahead with this work, as some varieties of peaches and nectarines hold their foliage rather too long, resulting in immature wood, which will not develop into fruiting-wood if the trees are not relieved of surplus growths early. The removal of these growths also helps to mature late-ripening peaches before the cold weather sets in.

The late varieties of apples will still remain to be picked. A good deal of later handling can be saved if all inferior fruit is removed at time of picking, and the good fruit separated into two sizes and stacked separately. The larger sizes can then be marketed first, leaving the smaller and better-keeping sizes for later despatch; this method also facilitates the work at packing-time. Where apples and pears are to be cool-stored the fruit should be packed and despatched immediately to the store. The condition of fruit and the length of time for which it will keep depend upon the consideration it receives at time of storing.

Where woolly aphis is still persistent spraying will be necessary; deal with this as soon as the fruit is all off. Save the laterals and spurs now by thorough spraying. Red spraying-oil can be used at this stage at 1–50 strength; in bad cases 1–40 will do no harm beyond perhaps a little leaf-spotting, which will not hurt at this stage. A lighter spraying of oil, at 1–60, plus a small quantity of Blackleaf 40 equal to 1–2,000, can be used with good results; the main point is to beat the aphis, or it will affect next year's crop as well as the future of the tree.

It is now time to consider the matter of trees for the season's planting, whether for replacing or additional areas. Order early, stipulating the grade and age of trees required; do not trust to luck, and find when the trees arrive that they are not what was required; a better understanding between the supplier and the purchaser will help to prevent disappointment. When the trees are ordered make preparation for their reception in the orchard by removing the discarded trees at once with a good portion of soil, replacing the latter with new soil which will have time to consolidate before planting season. A young tree planted where an old one has been usually requires good attention in this respect to give it a good start.

On new areas plough the land deeply in the autumn. Deeply well-tilled soil is the best foundation for an orchard, the effects of which will be evident throughout its existence. Shallow preparation of the land results in surface-rooted trees, which interferes with cultural operations and, in turn, affects the well-being of the orchard. —*J. H. Thorp, Orchard Instructor, Dunedin.*

POULTRY-KEEPING.

F. C. BROWN, Chief Poultry Instructor.

THE poultry-keeper who has acted upon the advice published in recent numbers of the *Journal* will now not only be well ahead of his work, but will also be working on sound and profitable lines. All surplus cockerels that have attained a marketable age, together with all unprofitable hens, will have been cleared out before this. The best hens, and also the best of the cockerels reared, will have been selected and marked for future breeding purposes. Further, they will be fed and managed in such a way that a healthy vigorous condition will have been attained when the mating-time comes around. The pullets will also be well settled down in their winter quarters, and probably be producing abundantly the much-desired winter eggs. On plants where these important matters have been neglected the owners will soon find out their costly mistake. For instance, with the great bulk of the hens now moulting it is next to impossible for even the keenest judge to separate the likely future profit-makers from those that should be culled. Thus there will be retained in the flock many weak and non-paying types of birds that could have been detected as such and culled out weeks ago. It should be ever remembered that successful culling and the selection of the most desirable breeding-hens can only be properly carried out at some time before the moulting-period sets in. Doing things right and at the right time is one of the main secrets in successful poultry-keeping.

FEEDING OF MOULTING HENS.

Now that the hens are moulting, do not on any account endeavour to economize in the food bill by giving the birds a mere living-diet. As is the case with all classes of stock, it is better to reduce the flock by half and feed the birds thoroughly than to put the whole flock on half-rations. Feed may be high in price, but nothing will be saved by stinting the moulting hen. Never forget that in the process of renewing her feathers the bird's system is put to a severe tax. Obviously, if a good healthy moult is to be gone through and early egg-laying promoted the food should not only be good but must be liberally supplied. The

only safe way to save the food bill is to provide an abundance of green-stuff, which the majority of poultry-keepers can grow themselves. Where watercress is available this is an ideal food for the moulting bird, and, in fact, for fowls of all ages. Where this valuable green material can be had by the poultryman merely for the trouble of collecting, it is easily one of the best assets it is possible for him to have. The fact of not having to grow any other green food for his flock must necessarily mean a considerable saving, in regard to both labour and expense.

PULLETS MOULTING.

Many reports have reached me of pullets going into a moult from no apparent cause, and just when dear eggs were expected. This is usually due to underfeeding, or the supplying of food which the birds do not relish. Sudden changes of food, or shifting the birds from one house to another, is often responsible for this undesirable moult. Of course, as a general rule, the very-early-hatched pullet lays a few eggs in the autumn and moults with or before the adult birds, and this very often in spite of receiving the best possible management. Even with the pullet bred to lay in April, moulting is apt to occur any time now if the treatment it receives is not uniform in every respect.

CROSSBREDS *versus* PUREBREDS.

A very common and a mistaken idea is that where profitable egg-production is to be maintained a crossbred bird is the one to keep for this purpose. An argument often brought forward in support of this contention is that the crossbred chickens will grow better and generally make greater progress than those bred from purebred stock. Maybe they do, and will return an equal profit, but only where size and table qualities are the chief objects aimed at. As regards heavy egg-production, however, we have no proof that a crossbred bird can be bred with any degree of certainty for this special purpose. On the other hand, the records put up in the egg-laying competitions give a striking testimony of the value of various pure breeds for phenomenal egg-production. From this it should not be inferred that these high-class laying-types are necessarily poor table birds. For example, there is the Black Orpington, which has won egg-laying tests against some of the best laying-strains of White Leghorn; and who can say that the former is not a desirable table bird? So the man who is anxious to build up a heavy-producing flock, and maintain them over a period of years, is well advised to breed on purebred lines wherever it is possible to do so. It is true that sometimes good egg-records are obtained from a first cross, but even in breeding these there is a much greater risk of having disappointing stock than there would be in breeding on pure lines. After all, it takes two purebreds to produce a first cross.

THE APIARY.

G. V. WESTBROOKE, Apiary Instructor.

PREPARATIONS FOR WINTERING.

At this time of the year there should be no necessity to open up the hives, if previous advice in regard to leaving the bees sufficient stores to winter on has been carried out. It is, however, desirable to insert additional mats in order to keep the hives as warm as possible. When the covers are removed for this purpose see that there are no cracks through which the damp can gain entrance during wet weather. It is of the greatest importance that the hives be kept as dry as possible at all times, and especially in cold weather. Where a cover is found to be defective it should be replaced with a sound one, and the faulty one repaired as soon as possible so as to be in readiness to replace any other when needed.

Another matter that should be given attention is the removal of all long grass or weeds that may obstruct the entrance to the hives. Where the entrances have not been reduced this should be attended to, leaving only sufficient room for a few bees to enter at once, and making them sufficiently small to exclude mice, which have a habit of taking up their abode on the mats of the hives during winter.

QUEENLESS COLONIES.

When during the last examination any hives have been noted to be queenless, these should at once be united to fairly strong colonies. This may be done by removing the cover and mats of the strong colony, in the evening, and placing a sheet of newspaper in place of the mat; the queenless hive is then lifted carefully on top, over the paper, taking care to disturb it as little as possible. This should leave no outlet for the queenless bees except by gnawing through the paper to the hive below. By this method the two colonies usually unite quietly. At this time of the year it is too late to attempt to raise queens for such colonies. Although one often reads of "autumn" queens, this description is misleading, as very few queens are raised in the autumn, but are in reality summer queens. Practically no queens are raised in March, which may be taken as the first autumn month. In fact, it would be very risky to attempt queen-raising during March owing to the danger of robbing. Laying-queens that are available, however, may with care be safely introduced up to April.

All utensils used in connection with the extracting should be carefully cleaned and put away, any parts that are liable to rust being coated with vaseline.

FOREIGN HONEY-PLANTS.

Before importing any foreign plants (or seeds) which are supposed to be good honey-yielders, beekeepers would be well advised to first consult the Department's Biologist, Wellington, so as to make sure that they are not introducing into the country a dangerous weed, which may eventually cost thousands of pounds to eradicate.

THE GARDEN.

W. H. TAYLOR, Horticulturist.

VEGETABLE-CULTURE.

THE season of short days and rain is now near—a time when gardens are in many cases neglected. It is no uncommon thing for the vegetable-garden at least to be left to become overgrown with weeds. Such crops as are left in the ground—carrots, parsnips, &c.—frequently become hidden with weeds. This is not the way to keep the soil in good heart, but it is the way to perpetuate weeds and get the garden well stocked with slugs, snails, wireworms, and other troublesome pests. The contention that weeds dug into the soil supply necessary humus may be right in theory, but it is a very bad practice for all that. When added humus is necessary it is better supplied by a special crop grown at an opportune time than by allowing the garden to become stocked with weeds. "One year's seeding, seven years' weeding," is an old and true saying. A weedy garden causes a lot of labour that ought to be and would be unnecessary if a proper system were adopted and maintained. It costs less effort to keep a garden clean than to grow stuff in a half-tended place, and if a system of clean cultivation is maintained the work becomes much easier after two or three seasons by reason of the diminishing number of weed-seeds left in the soil. The soil should be kept as clean in winter as in summer. The effects of sun and air on clean soil are very beneficial. Far greater good is done in that way than can possibly be done by digging in weeds. Slugs, snails, and wireworms never stay long where there are no weeds or other vegetation to harbour them or to feed upon, and birds are able to pick grubs out of the freshly broken ground. For these reasons all vacant plots should be turned over, and coarse weeds should be cleared from ground holding crops of carrots, parsnips, &c.

Liming should not be neglected. Soil becomes acid unless limed occasionally, and especially where acid fertilizers are much used liming is a pressing need. An acid soil breeds the fungus that causes club-root in cabbages, turnips, and other plants of the cruciform family. It is also strongly suspected of being largely responsible for eelworm, a pest that has been troublesome—as is the case with the club-root disease—only since the use of acid fertilizers became general.

Current Work.

Advancing crops of broccoli, cabbages, savoys, kale, &c., should be moulded up as they require it. Weeds are sure to be present, and the operation of

moulding should be done before these make too much headway. The soil thrown up from between the rows, either by plough or with a hoe, according to the size of the plot, should be made to cover the weeds between the rows of plants; those in the rows are, of course, covered during the operation. If the plants are doing well, and are set at proper distances, growth should practically meet from row to row, and this will suppress further growth of weeds.

Parsnips, carrots, and Jerusalem artichokes should be left in the ground to be dug as required for use. Neither of these crops keep well in our climate when out of the ground, and the flavour—at least, of carrots and parsnips—is impaired by storing, in whatever way this is done.

Seedling cabbages and cauliflowers from the autumn sowing should be looked after. Cauliflowers, of the early kind at any rate, should be pricked off as soon as they can be handled, either in beds of soil under lights, in boxes, or in the open ground, according to the exigencies of the case. Beds of seedlings should be kept free of weeds, and, if sown in lines, the soil between the lines of seedlings should be frequently loosened.

Asparagus: The tops are now either dead or nearly so and should be cut down. Cut close to the soil, rather under than above the surface, because, if left exposed, the stubs, which soon become hollow, form a very congenial shelter for slugs and woodlice, and these are not easily dislodged. The proper treatment for the bed depends on its style. If it is a bed in accordance with the old plan, strip off the soil down to the crowns. This can be done by loosening the soil with a fork and raking it off into the alley each side of the bed. The bed should then be given a coat of stable manure, which should be just so far decayed as to prevent further heating, but should on no account be of the description known as "fat." It should be of a littery nature, and the coat should be 1 ft. thick. The soil removed is not to be returned until spring. If the plants are in lines on the flat—as now advised—weeds may be hoed off, or the soil lightly forked if the roots will allow it, and a coat of manure placed over the roots. Where stable manure is not available other fertilizers must be used, but not yet a while.

Seakale: The season's growth being now completed, the old leaves should be cleared away and the soil around the clumps forked over. A light dressing of salt may be given to destroy slugs or other soil-pests. The crowns may be forced at any time while dormant. Cover each clump with a box which has the bottom removed and the top loose. The loose top is then laid on and the box surrounded and covered with fermenting manure. Before the box is covered strew soot and lime freely inside; this will prevent wireworms or other insects rising from the soil to nibble the sprouting heads. The covering of manure should be about 1 ft. thick. The heads should be ready to cut in about fourteen days from the time they are covered. When cutting, take a piece of the old stump with each head, so that the latter will be entire, and not in separate leaf-stalks. When cut, the heads should be about 10 in. high, and the leaf-stalks creamy-white in colour. The leaves should be just beginning to form, and should be white with pink edges. This mode of forcing is not in accord with the method described in Old Country books of the present day, which consists in lifting the stools from the open ground and forcing in heated greenhouses. The same plan is advised in some New Zealand publications, but except in rare instances it is not practicable in this country.

Peas: In the warmer parts of the Dominion, which include certain special localities widely spread (some being in the South Island), peas are sown at any time from March onward. In the hottest districts full advantage should be taken of the opportunity to get early crops, as midsummer crops rarely succeed, and without early crops the pea season would be very short. So far as concerns normal places there is nothing to be gained by sowing early, as in these conditions the peas will not flower till October.

Broad beans are sometimes sown much too early. Except in extra-warm places they should not be sown before June. They will not set beans till well on in spring, giving the first gathering near the end of October. If they are sown too early it merely means tall haulm with the lower portion barren, and tall haulm is a disadvantage.

Runner beans: When clearing away the sticks and the old vines remember that the roots of scarlet runners, whatever name they may have, are perennial, and that the second year's crop is usually more prolific than the first. Leave the roots undisturbed; lightly fork the soil over, not deep enough to touch the crowns.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

CREAM-CHURNING TEMPERATURES.

W. J. McNALLY, Martinborough :—

Could you kindly tell me the correct degree of temperature at which cream should be churned ?

The Dairy Division :—

The temperature which may be considered as correct is that which results in the churning-out of the butter in a reasonable length of time with the minimum loss of fat in the buttermilk, and gives a body of the most desirable character. Temperatures of 46° to 56° F. can be used to effect this, according to the locality where the butter is made and the period of the year. In early spring the temperature may be 48° to 50°, increased to from 52° to 54° in late autumn, and this varied 2° higher or lower according to locality. Water used for the breaking of the churning and for washing the butter-granules should be 3° to 4° lower than the churning-temperature.

CLUB-ROOT AND BRASSICA CROPS.

"SWEDE," Omoana :—

A first crop of swedes on good land newly stumped shows signs of club-root, especially on patches where turnips were thrown to cattle over a fence from the adjoining crop of swedes (second crop), which showed no club-root of any consequence. I presume that it is useless to sow swedes as a second crop on the first-named land. The crop is for rearing lambs, and on referring to the *Journal* of September, 1918, p. 135, I notice that Buda kale is stated to be good, though reliable seed is difficult to obtain. Would club-root in any way affect this crop on the tainted land, or can you recommend something better for the purpose—turnips, in every other way so suitable, being impossible ? I would also like to stump, plough, and sow swedes on an adjoining piece of land now in original grass on which the lambs on the turnips with club-root used to run each night. Do you consider that this grassland will now be infected and would transmit club-root to a crop of swedes grown on it ? If you know of a turnip fairly immune I would be glad if you would name it in your reply.

The Fields Instruction Branch :—

If land is free from club-root second crops are often successfully grown, but where club-root has made its appearance it is very risky to attempt to grow a second crop of swedes or turnips. Rape and Buda kale also belong to the Brassica family and are attacked by club-root, but they are often successfully grown after a crop of swedes that had been slightly affected with club-root, though this is not good practice, and we do not recommend it. If you must do so, grow rape or Buda kale in preference to swedes or turnips for the second crop. For tainted land we would suggest that you drill 1 lb. of Buda kale seed, then roll and sow 20 lb. Italian rye-grass and 5 lb. red clover per acre. The land which you propose to stump, although slightly affected, should grow a good crop of swedes, but a second crop would probably be badly affected. We are testing a number of new varieties of swedes, but up to the present have found nothing among the commercial varieties to beat Superlative for club-root resistance.

TRANSPLANTING LARGE LEMON-TREES.

E. A. ROBOTTOM, Taradale :—

Would you please inform me if it is possible to move large lemon-trees which are now in full fruit. Building operations have rendered this necessary. If it is possible, please advise also the most suitable time to move them and the best means of doing so.

The Horticulture Division :—

Were the trees any other than citrus the advice given would be not to attempt transplanting; planting young trees would be more satisfactory. Being citrus trees that are doing well it may be worth while. The success of the operation will, however, depend on the state of the roots. If these are mainly long and straggling successful transplanting would be very doubtful, but if the trees are well furnished with numerous roots not far from the boles of the trees they may transplant very well. If a good rainfall is experienced the month of May will be a suitable time. The heads of the trees must be reduced to a considerable extent to compensate for loss of roots. Dig a trench all round the tree 3 ft. from the bole and deep enough to cut all roots, using a sharp spade. Then cut under the tree, removing the loosened soil so as to leave the tree standing on a solid ball. Then with a fork loosen the soil from the upper edge of the ball until the tree is light enough to lift. When replanting, the soil should be trodden as firmly as possible above the ball of roots, but the surface soil should be left loose.

FLYING-ANTS AND POULTRY.

G. F., Tokoroa :—

We are troubled during March and April by flying-ants, which cause instantaneous death to the poultry. On examining the dead birds we find in each case a large ant in the throat. Can you suggest preventive measures ?

The Chief Poultry Instructor :—

This trouble is very difficult to prevent. Perhaps the only safe course is to confine the birds in the house when they are observed to be chasing and eating the ants. If a handful of lime is placed in the drinking-water the birds will often drink this after eating the ant and then expel the insect. This plan should be tried, as it may have the desired effect. As before stated, however, the only safe course is confining the birds when the ants are about, which is usually before a warm shower.

PREGNANT EWES ON SWEDES.

"CAMPUS," Otaki Railway :—

Would the running of pregnant ewes on swedes have any detrimental effect upon the sheep ? If not, what period should elapse between their removal from the swedes and the commencement of lambing ?

The Live-stock Division :—

The feeding of pregnant ewes upon swedes should have no detrimental effect provided they are fed in a proper manner. If the roots are fed off direct in the field the ewes should be given a daily run off into a clean paddock, and further feed given if necessary. The roots may be fed up to the time of lambing, but the ewes should not be allowed to get too fat.

CONVERTING SCRUB TO GRASSLAND.

C. F. LAXTON, Kauri :—

I have about 40 acres of land on my farm covered with small tea-tree 1 ft. to 2 ft. high and growing very thickly. Fern is also growing amongst it. I should

be glad if you could advise me as to the best and most economical way to eradicate this growth and establish permanent pasture. Is there a mower or scrub-cutter manufactured to deal with this kind of growth and which could be used for ordinary farm purposes ?

The Fields Instruction Branch :—

The most economical way of dealing with manuka scrub and fern would be to cut with a machine supplied by Messrs. McCormick or Massey-Harris. This machine has a short cutting-bar made specially for the purpose. We would suggest that the scrub be cut during the winter or early spring months and allowed to lie until the following March, when it could be burnt and the seed sown. The machine mentioned can be used for ordinary farm purposes as well.

CRACKING OF GRAPE-BERRIES.

T. S. M., Timaru :—

I have a King George grape-vine the berries of which crack so badly that few of them ever get properly ripe. The trouble starts about the time the berries begin to colour. Advice as to means of prevention or control will be welcome. The vine is grown along with Black Hamburg vines and receives similar treatment. With me the former variety does not appear to be readily self-fertilizing, and being later than the Hamburg evidently receives no benefit therefrom.

The Horticulture Division :—

Cracking may be due to several causes. It is actually caused by the skin of the berries not being sufficiently elastic to respond to the swelling of the pulp. This condition may be brought about by opposite causes. The grapes may be nearly ripe and swelling in a normal way nearly finished. In such cases the skin is not able to stretch much more and a sudden swelling of the pulp must then result in cracking. The swelling of the pulp may be caused by absorption of moisture through the pores of the skin ; this results from a very humid atmosphere. The way to prevent it is obvious—avoid such conditions by free ventilation. Other causes are dryness of atmosphere and dryness at root at an earlier period. Either condition would cause the skin on the berries of some kinds of grapes to be very hard, so that they would not have the elastic quality necessary to enable them to respond to sudden pressure, which might be caused by a very humid atmosphere or a sudden and copious increase of soil-moisture. The remedy for cracking is to give the vines the conditions suitable for the different periods of growth, both as regards the soil and the atmosphere of the vinehouse. Vines that have scanty or poorly developed leaves are those that are most subject to cracking.

COWS WITH FOUL-IN-THE-FOOT.

"SETTLER," Matainui :—

I am having trouble with several of my cows, which seem to be affected by an unusual kind of foot-rot, the symptoms being as follows : The foot swells all round the crown of the hoof, and the swelling gradually extends up the leg to the knee, being apparently so painful that the cow can hardly move about. The inflammation comes to a head just above the cleft of the hoof and bursts like a huge boil. I treated some cases by applying hot fomentations, and after a couple of days removed a large "core" of apparently solid pus about the size of one's thumb, which left a large hole in the foot. After this the cows seemed relieved and the swelling went down. I then applied an ointment of Stockholm tar and boracic acid, which seems to have fixed matters up. Could you tell me what the trouble is and the probable cause ?

The Live-stock Division :—

Judging by the symptoms given the affection from which your cows are suffering is what is commonly known as foul-in-the-foot. This complaint is

common where cattle are grazed on wet swampy land where water lies stagnant. All stagnant water becomes a breeding-ground for germs (micro-organisms). The cause of foul-in-the-foot is a germ which on entrance to a slight wound causes death of the surrounding tissue; inflammatory action is set up, and a piece of dead tissue is sloughed out. This is precisely what is taking place in the hoofs of your cattle. Your treatment is correct. Once the "core" has become removed the treatment is simply to keep the wound clean until healed. Stockholm tar is the best for wounds in the region of the feet. The cows should be grazed on dry pastures, and if there is any stagnant water through which the cows must walk on their way to the bails this should be drained. Very often simply walking cows through stagnant water causes the disease.

DUCK-KEEPING QUESTIONS.

"DUCKS," Paeroa :—

Is there any way of distinguishing old ducks from young ones after the former have moulted? How long should ducks be kept for laying? Is their second year the best, as with hens? Can they be kept successfully in a small run—say, 15 ft. square?

The Chief Poultry Instructor :—

Old ducks may be distinguished from the young ones by ascertaining the condition of the windpipe. If this is slightly squeezed between the forefinger and thumb it will be found soft and yielding in the case of the young, and hard and resisting in the old birds. Indian Runner ducks may prove profitable to keep for three years, and in some cases even longer, but, like pullets, they usually produce their maximum egg-yield during the first season. Keeping ducks in a small enclosure, particularly where the run is in close proximity to the dwelling-house, is not recommended, as usually the run, especially during wet weather, gets into an insanitary state.

BROWN-TOP AND DANTHONIA FOR PASTURE.

A. N. and S. McLEOD, Tatu :—

Will you please give us some information about the feeding-value and habits of Waipu brown-top and Danthonia pilosa? It is necessary to sow them on this country, and we would like to know whether they crowd out cocksfoot and clovers, as is the general impression.

The Fields Instruction Branch :—

Danthonia pilosa and Waipu brown-top should suit your district admirably. The brown-top will give you an abundance of feed for the winter months; it stands drought well, and will thrive on the poorer classes of soil. It is a true perennial, and fairly palatable to stock. Danthonia pilosa grows good feed during the spring and stock thrive very well on it. It becomes less succulent during the summer months, and is found very useful when grown among manuka scrub and fern for burning off. Neither of these grasses would injure cocksfoot or clovers.

BREEDING FROM TWO-TOOTH EWES.

M. M., Matainui :—

Please advise me as to whether the progeny of good two-tooth ewes would be as robust as that of older sheep.

The Live-stock Division :—

Provided the two-tooth ewes are healthy, well grown, and generally in good condition there is no reason why their progeny should not be quite as robust as that of older ewes.

NEW ZEALAND FOREST POLICY.

STATEMENT BY THE COMMISSIONER OF STATE FORESTS.

THE following statement, presenting an informative summary of the Government policy in regard to forest-working in New Zealand, was made recently by Sir Francis Bell, as Commissioner of State Forests :—

A true forest policy may be expressed not in terms of the size of the country's forests, but in its effectiveness in securing the most efficient possible utilization of the nation's wood resources. The policy must provide confidence and security in every legal and commercial phase to industry and public alike. It must assure—(1) Ample timber-supplies at reasonable prices both in the present and for the future for the people of New Zealand ; (2) protection and regulation of stream-flow by the maintenance of protection forests ; (3) maintenance as productive forest capital on non-agricultural areas which might otherwise be turned into idle impoverished wastes ; (4) transferring to forest-management all existing and future forests where water conditions, soil-fertility, climate, and public health are dependent upon them.

BASIC REQUIREMENTS.

Some basic requirements for the effective operation of the forest policy are—(1) A continuity and stability of policy ; (2) a modern and comprehensive forest law ; (3) a progressive timber-sale policy ; (4) permanent dedication by Act of Parliament of all forested non-agricultural Crown lands to forest-management (up to the limits required to produce—by a sustained-yield management—the Dominion's timber needs) ; (5) adequate forest-development funds for afforestation protection, education, and research.

To fulfil these requirements it is necessary to make provision for—

1. Classification of the soil capabilities of all provisional State forests, with a view to the dedication of sustained forest-management of all areas more suitable for the production of forest crops than agricultural or pastoral crops (other lands to be opened for settlement).

2. Demarcation and forest organization of all permanently dedicated State forests, with the application of applied forestry principles to the production of sustained timber crops in perpetuity.

3. Conservation of all forested regions from which flow streams, or upon which are dependent the water for hydro-electric projects, irrigation schemes, the water-supply of communities, &c.

4. Steady acquisition of forest lands from the Native owners ; classification and dedication to forest-management of all suitable areas so acquired.

5. Application of a forest-fire prevention control (after the situation has been carefully studied) throughout the Dominion's forested regions. (Fire is one of scientific forestry's greatest enemies.)

6. Gradual building of an effective administrative instrument—a State Forest Service, manned largely by New-Zealanders who have been trained in technical forest schools in New Zealand, and who will then be capable of successfully carrying through the forest policy.

7. Establishment of a professional course in forest engineering for the training of forest technicians by a faculty of forestry in a University college, and two State ranger schools—one in each Island.

8. Unified control and administration of the permanent and provisional State forests by one administrative body (the Forest Service) as regards all activities, such as sale and disposal and protection of the timber ; the grazing-rights ; kauri-gum-digging privileges ; and all other uses and privileges within their boundaries.

9. Reinvestment of all realized revenues from the disposal of State forest and provisional State forest timber in the construction of improvements within their boundaries, such as roads, tracks, telephone-lines, and other means of communication, ranger stations, boundaries definition, internal demarcation and other needs of forest organization, and local development.

10. Allocation of, say, 20 per cent. of all net revenues received from the sale of virgin timber to the county within whose boundary the forest or forests are located, for the purpose of building and maintaining roads and bridges, and for educational purposes.

11. Formation of a small advisory Forestry Board to advise the State Forest Service on matters concerning its activities; such Board (honorary) to consist of one appointee from the forest industry, forest labour, the consuming public, and the agricultural industry respectively.

12. Promotion of forest research—looking to better utilization and handling of forest products, to aid in the management of State forests, and to solve the problems of forest-fire prevention, the silviculture of the native trees and their regeneration.

13. A more exhaustive study of the possibilities and practical application of forest fire insurance.

14. Diffusion of knowledge regarding the forests and forest resources of New Zealand.

15. A survey or census of the forests—quantities of timber available to industry, present and future needs, territorial requirements, productivity, and other information needed to deal with forest problems intelligently.

16. Restriction of timber-export—the timber of New Zealand for the people of New Zealand; the exploitation of New Zealand forests to keep pace with the domestic needs of the Dominion.

17. Consistent and steady afforestation by the State in the Rotorua, Hanmer Springs, and Tapanui districts of about 4,000 acres per year. (Concentration in those regions where demonstrated results are best and the local needs are most urgent.)

18. Financial assistance by the Government to co-operative profit-sharing tree-planting schemes desired by local governing bodies, County Councils, municipalities, &c. Extension of co-operative assistance to private individuals who are desirous of carrying on private forestry operations by the supplying of forest-planting material at low prices, competent technical advice, and assistance in the formation of working plans.

SALE OF TIMBER.

A progressive timber-sale policy is a vital need and component of any broad national forest policy.

With some exceptions, New Zealand is not receiving even approximately the market price for her standing timber disposed of to concessionaries. It goes without saying that, as stewards of the people, the Government is responsible for the careful administration of all natural resources. It therefore behoves the legislative authority to see that a fair return is attained from the sale of the Dominion's timber resources, at the same time considering the interests of the timber industry and of the consumer.

The timber-sale policy should be one that gives a fair and just measure of certainty to concessionaries, and therefore stability. It should provide for a more equitable return than under present conditions (concessions such as sawmill licenses, licenses under the mining Warden, &c.), and proportionate increases in the future. (It is fortunate that the principle of Crown timber royalties is generally in use, inasmuch as it represents the principle of profit-sharing by the people in the industries which develop the timber resources.)

A fair timber-sale policy should provide for—

1. Sale of public timber in such a manner that it contributes to the people's welfare in the highest practical degree.

2. A procedure which will eliminate definitely and fairly the uncertainties which have disturbed and hampered forest industry—namely, indefinite policy, ambiguous regulations, erratic supervision, uncertain tenure.

3. Granting of all reasonable facilities to actual and *bona fide* millers in order to permit of adequate investment and profitable return, and so that forest-conservation may not be a remote but a near and more profitable thing upon all areas over which milling-rights are granted.

4. Formulation of a forest law and regulations which will effectively discourage timber-land aggregation, and prevent trafficking and speculation in the resources of the Dominion.

5. I am in favour of providing in the new forest law a clause preventing the transfer of any timber-sale made by the new regime. This principle will have to

be ultimately recognized if applied forest-management is to prevail. In countries where a conscious forestry control is now in force—France, Germany, Norway, Sweden, Canada, British Columbia, United States—this principle applies. (The philosophy of it is: The State holds at all times a full control over its contract; there is no granting of vested interest to the standing-timber purchaser; it reaps the unearned increment—and justly so. It will be seen that ultimately the sale price will equal the cost of production, so that for self-protection it must maintain a firm control of its property.)

6. As a general principle it is desirable that in the development of administrative procedure the settlement of all local questions be upon local grounds, in each case considering the dominant industry, but with as little restriction to minor industries as possible.

7. The Commissioner of State Forests and his administrative instrument—the State Forest Service—is the one branch of Government empowered and responsible for the control, disposition, and sale of all forest resources within State forests and provisional State forests.

8. The people are entitled at all times to the full market value of all standing timber disposed of. This principle is a just one to all concerned. In order that this may always be attained, all timber-sales should be subjected to public competition (exceptions—small sales of nominal value; the limit to be fixed by the Minister in charge). It is further proposed that no timber should be sold for less than its appraised market value (minimum fixed from time to time).

9. State timber should be sold in the round by one of the standard units of measure of the service—namely, solid cubic feet, or superficial measure of 100 ft. (1 ft., board measure, equals a board 12 in. by 12 in. by 1 in. deep).

10. Sales of timber in small quantities should be encouraged by every possible means. As far as practicable the rate at which timber is sold from any unit should ensure a reasonable operating life for mills constructed in connection with sales. It is not desired to sell timber in such a manner that any one mill would have a monopoly, but the amount to be cut from year to year should be regulated so that established plants, if successful competitors for timber offered for sale, can be assured continued operation for reasonable periods. Furthermore, no sales should be made which endanger the future supply for local use or the maintenance of local industries.

11. All felled timber to be branded and properly measured before removal from the sale area (in the discretion of the competent officers measurement may take place at the point of milling).

12. The State Forest Service should have full charge of silvicultural policy, over all timber-sales from State forests or provisional State forests, or any other forest under its control, and, to the extent of protecting the public interest, should be granted sufficient supervision over manufacture to require the use of efficient machinery for the prevention of excessive waste. Only those restrictions would be imposed upon operators which are essential to the sound and conservative silvicultural management of the forest; and, as far as practicable, the conditions of exploitation should be adapted to the established and necessary methods of logging and milling in the region.

13. All timber-sales should be subject to the following: (*a*) Ground-rent; (*b*) royalty; (*c*) forest-fire-protection charge (if desirable); (*d*) payment of all expenses in connection with the survey, appraisal, and advertisement of sale; (*e*) the furnishing of a bond or guarantee of performance; (*f*) time-limit of operation; (*g*) provision for adequate penalties for non-observance of conditions of sale and regulations.

14. A revision of the minimum royalty schedule should be made without delay, in order that the State's interest may be brought into line with the current timber-values (the British Columbia system of periodic revision is sound and satisfactory).

15. By the end of the year 1923 all timber cut from State forests or provisional State forests should be scaled or measured by licensed scalers (a license to be granted by the Forest Service to applicants on proper examination and approval—this is in successful operation throughout Canada).

16. Adequate forest-fire-protection safeguards should be required in all timber-sales.

ANTICIPATED RESULTS.

The operation of this New Zealand forest policy should result both in the present and in the future in—(1) Continued supplies for wood-using industries at the lowest possible cost; (2) a continuous and sustained supply of timber to

meet the local and national needs of the people of New Zealand; (3) adequate protection of all water-supply sources and safe control of stream-flow; (4) utilization of all forest soils at their productive capacity; (5) the closest use of all the forest resources of the people; (6) stability of the timber industry.

FRUIT-TREE-GRADING REGULATIONS.

THE original regulations governing the grading of fruit-trees for sale from nurseries have been revoked, and the following regulations made in their place, taking effect from 18th March:—

1. In these regulations, if not inconsistent with the context,—

"Diameter" means the diameter of a fruit-tree measured 2 in. above the union:

"Fruit-tree" means any variety of apple, pear, apricot, peach, or nectarine tree:

"Nursery" means any land which is used for the raising or growing of any fruit-trees, if such fruit-trees or any of them are intended for sale for replanting:

"Sale" or "sell" includes barter, and also includes offering or attempting to sell or exposing for sale, or sending or delivering for sale, or causing or allowing to be sold, offered, or exposed for sale.

2. (1.) On every sale of fruit-trees from a nursery, whether direct or through an agent, there shall be issued, by or on behalf of the occupier of such nursery, to the purchaser or intending purchaser a statement of the grade of such fruit-trees, determined as hereinafter set out. (2.) Such statement as to grade may be set out in the invoice, or on a tag or label attached to the fruit-trees, or in some other suitable manner.

3. The grading of fruit-trees from a nursery shall be done by or on behalf of the occupier of such nursery prior to the sale of such fruit-trees.

4. The following are the standards by which the grade of apple or pear trees shall be determined: (1.) "A (or Commercial) Grade" shall consist of trees the diameter of which is not less than 7/16ths of an inch nor more than 10/16ths of an inch: Provided that trees which are more than 10/16ths of an inch in diameter may be included in this grade if such trees are not more than one year from the bud or graft: Provided further that in the case of the following varieties of pear-trees—viz., Winter Nelis, P. Barry, Marie Louise, and Josephine de Malines—trees may be included in this grade the diameter of which is not less than 6/16ths of an inch. "B (or Nursery) Grade" shall, subject to the last preceding proviso, consist of trees the diameter of which is less than 7/16ths of an inch. "C (or Special) Grade" shall, subject to the first proviso in the case of A Grade, consist of trees the diameter of which is more than 10/16ths of an inch. (2.) Apple or pear trees of all grades shall be well rooted, and if branched shall be of fair shape and shall have not less than three branches averaging 18 in. in length.

5. The following are the standards by which the grade of apricot, peach, and nectarine trees shall be determined: (1.) "A Grade" shall consist of trees the diameter of which is not less than 8/16ths of an inch; "Under Grade" shall consist of trees the diameter of which is less than 8/16ths of an inch. (2.) Apricot, peach, and nectarine trees of A Grade shall be well rooted and branched and of fair shape.

6. In the grading of fruit-trees there shall be allowed a margin of error: Provided that in any one consignment of fruit-trees forwarded from a nursery to a purchaser the margin of error shall not exceed 5 per cent. by number; and provided further that where the error relates to the diameter of the trees no greater margin than 1/16th of an inch shall be allowed.

7. If any purchaser of fruit-trees from a nursery is dissatisfied as to the grading of such trees he may make complaint to an Inspector, but such complaint must be made within fourteen days of the receipt of such trees by the purchaser.

8. Every occupier of a nursery who—(*a*) Sells any ungraded fruit-trees from such nursery; or (*b*) sells any fruit-trees from such nursery without issuing to the purchaser a statement of the grade assigned to them; or (*c*) sells any fruit-trees from such nursery which are incorrectly graded—commits an offence against these regulations, and shall be liable on conviction to a fine not exceeding £20.

HAWTHORN IN RELATION TO FIREBLIGHT.

THE NOXIOUS WEEDS AMENDMENT ACT, 1921.

FOLLOWING is the text of the Noxious Weeds Amendment Act passed during the recent short session of Parliament, dealing with hawthorn in connection with the control of fireblight in fruit-trees :—

Short Title.

1. This Act may be cited as the Noxious Weeds Amendment Act, 1921, and shall be read together with and deemed part of the Noxious Weeds Act, 1908 (hereinafter referred to as the principal Act).

Hawthorn may be declared a Noxious Weed.

2. The Third Schedule to the principal Act is hereby amended by inserting therein, after the reference to "Hakea," the word "Hawthorn."

Order declaring Hawthorn a Noxious Weed may be limited to Part only of District.

3. Notwithstanding the provisions of paragraph (*c*) of section five of the principal Act, a special order under section four of that Act, made by any local authority with respect to hawthorn, shall, according to the tenor of the order, be in force throughout the district of the local authority, or within such part or parts only of the district as may be defined in that behalf in the order.

Offence to plant Hawthorn.

4. The planting of hawthorn is hereby prohibited, and every person commits an offence against the principal Act who propagates hawthorn in any manner, or who does any act with intent to propagate hawthorn, or who sells any seeds, plants, or cuttings of hawthorn.

PRESERVATION OF TIMBER ON THE FARM.

THE first essential in carrying out any preserving process for timber is that the timber should be thoroughly dry and seasoned. There are numerous chemical preservatives on the market. Coal-tar creosote is an efficient preservative providing it is properly applied and is of the right quality. But it should be remembered that coal-tar is an extremely complex mixture of organic compounds, varying with different coals and with different treatment of the same coal, which will yield at the same plant various qualities of coke, gas, and tar, depending on the amount of heat applied, the quantity of air admitted, and the season of the year. Obviously, therefore, more certainty of efficiency, as well as vastly better appearance, is secured by making use of some specially prepared mixture of approved reputation. Creosote may be applied (1) by means of a brush in exactly the same way as tar is usually employed, but applied in this way it is not so efficacious as tar ; (2) by placing the timber to be treated in an open tank containing the creosote, and boiling the whole for several hours. An original British wood-preservative named Jodelite (probably consisting largely of creosote) has been used for nearly thirty years past. It is efficient against fungus, dry-rot, decay, or parasitic insects, is easily applied to existing structures, and penetrates without pressure. One gallon will cover 25 to 50 square yards, according to the nature and surface of the timber under treatment.—*Public Works Department.*

Wheat and Oats Threshings.—Returns of actual threshings received to 21st March by the Government Statistician from millowners showed that until then 1,301,968 bushels of wheat and 733,347 bushels of oats had been threshed out. The average yields per acre in cases where particulars of areas were furnished (covering 99 per cent. of total threshings) worked out at 33·33 bushels for wheat and 34·65 bushels for oats.

PURE IMPROVED SEED-WHEATS.

THE pure improved seed-wheats described in the first article of last month's *Journal* are now available for distribution, the varieties and prices per bushel being as follows: Solid Straw Tuscan and White Straw Tuscan, 9s. 10½d.; College Hunters, 10s. 1½d.; Velvet and Pearl, 10s. 4½d.; sacks extra at current price. Orders will be taken by the Department of Agriculture, Christchurch.

LAND FOR DISCHARGED SOLDIERS.

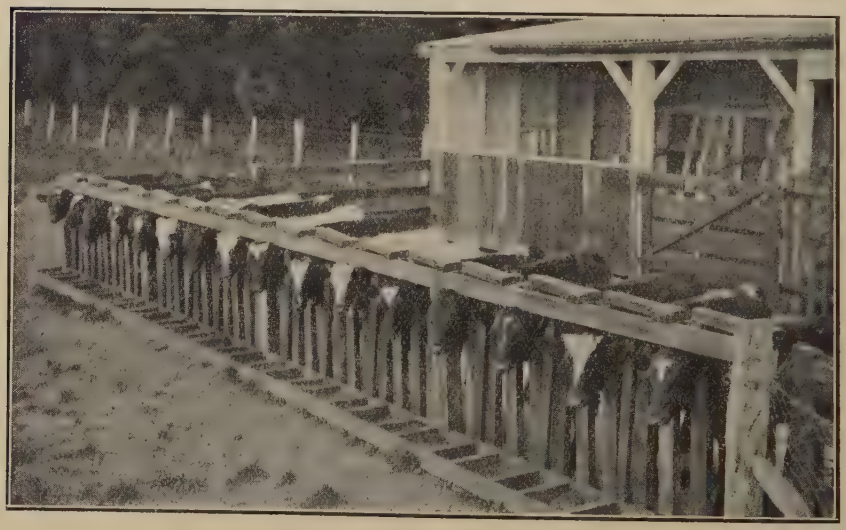
THIRTEEN dairying sections in the well-known Reporoa Settlement, between Rotorua and Taupo, will be balloted for on 25th May. Eight sections in Haunui No. 2 Settlement, near Wangaehu Railway-station, Wellington District, will be available on 5th May. One pastoral run of 21,200 acres, in Canterbury, is to be balloted for on 24th May. Fourteen sections in Pukeawa Settlement, at Balclutha, Otago District, will be opened on 25th May.

In addition to these areas and others lately specified, there is a considerable number of sections in all land districts not yet taken up. The Crown Lands Guide, obtainable at any Land Office, gives full particulars of these available sections.

FORTHCOMING AGRICULTURAL SHOWS.

Franklin A. and P. Society: Pukekohe, 18th to 21st May (Winter Show).
Otago A. and P. Society: Dunedin, 31st May, 1st to 3rd June (Winter Show).
Waikato Winter Show Association: Hamilton, 31st May, 1st to 4th June.
Manawatu and West Coast A. and P. Association: Palmerston North, 21st, 22nd, 23rd, and 24th June (National Dairy Show).

(A. and P. Association secretaries are invited to supply dates and location of their shows.)



TEST CALVES IN FEEDING-BAILS, RUAKURA FARM OF INSTRUCTION.

(See first article in this issue.)

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THE NORTHERN GUM LANDS.

OPERATIONS AT THE PUWERA EXPERIMENTAL AREA.

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THE North Auckland Peninsula comprises an area of 3,743,360 acres, of which almost one-fourth consists of gum lands. To those but slightly acquainted with the Auckland Province and its soils the term "poor gum lands" is merely a phrase. Not only are there gum-land soils of different qualities, some being distinctly good, but there exist also many diverse types. They vary within wide limits in their physical and chemical composition, and no doubt biological also.

South of Dargaville, stretching down towards the Kaipara Heads, bounded by the Northern Wairoa River on the east and the sea on the west, there is a great extent of gum land with a soil mostly of a light sandy nature. Interspersed throughout this area are found swamps varying in size and composition, some being peaty. Below the sandy soil, at depths ranging from some inches to several feet from the surface, is found a hard-pan of sandstone showing oxide of iron as a binding-material to the sand-grains. Although the soil is loose, easy to work, and needs consolidation to get tilth, it is sour. When the pan is near

the surface, root-development is necessarily limited, with consequent detriment to plant-growth. About two years ago grassing experiments were started on Mr. Colmore Williams's farm, near Dargaville, on gum land of this nature, by the Auckland Education Board with some assistance from the Department of Agriculture. Results indicated that where Waipu brown-top entered into various mixtures of good English grasses and clovers, after the first season the brown-top began to show up freely and subsequently took possession of the pasture.

On the other hand, the gum lands also comprise extensive areas of white-pipeclay soils. On digging down one finds abundant ironstone nodules, the iron being present as limonite. These soils are difficult to work, chiefly because of their colloidal character. When wet they are sticky, and will puddle if worked with implements. When dry they set hard. It is very easy by faulty methods of cultivation to produce a plough-pan and generally spoil the texture of the soils. Under natural conditions the fine clay below the top soil is inclined to form a layer retarding root-growth.

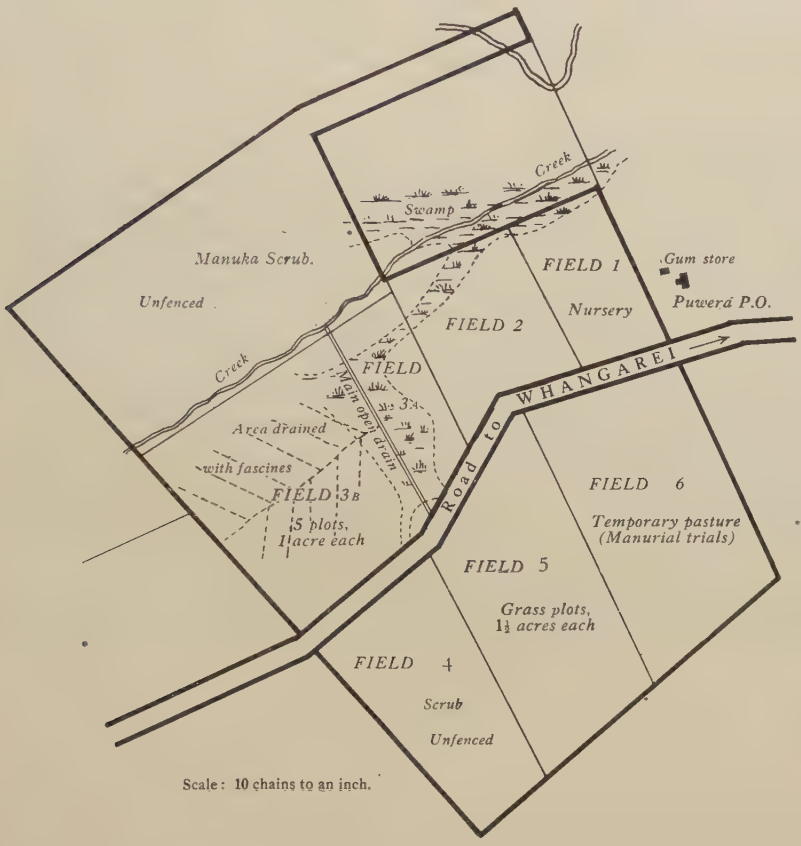
Between these extreme limits are found many intermediate types. Some are loams, ranging from medium to stiff, and of comparatively good quality. On the Gum Lands Experimental Area, at Albany, nine miles from Auckland, may be found soils of the better type as well as of the poorest.

Puwera, eight miles from Whangarei, upon which the work mainly referred to in this article is in progress, belongs to the white-pipeclay type. It is perhaps the poorest, and certainly the most intractable, kind of gum land found in the province. The soil possesses little humus, a deficiency that increases the tenacity of the clay. The drainage is naturally bad, and it has been made worse by the gum-digger's spade when prospecting or digging for gum. As would be expected, these soils are very sour. Settlers on these areas freely admit that by using orthodox methods of cultivation they intensify rather than ameliorate the bad chemical condition of the virgin soil. If this reversal of the results of ordinary cultivation is due to wrong methods, then there is work and hope for the investigator.

THE PUWERA EXPERIMENTAL AREA.

The Puwera Experimental Area, instituted and operated by the Department of Agriculture, is about 100 acres in extent. The land slopes down on both sides to a small stream, which divides the place unequally (see sketch-plan). Swampy conditions obtain near the creek, but fringing the wet land on both sides are patches forming broken strips of fairly good loam, formed no doubt from the wash off the adjoining slopes. This soil is free to work and contains a fair proportion of humus, giving it a dark colour, which contrasts with the clay on the steep slopes. Excluding this small portion of loam, clay makes up the total area. It is not an uncommon experience, and is pleasing to record, that such small areas of comparatively good loam are to be found throughout the poorer soils. These are usually on the lower levels near a stream. The prospective gum-land settler who can secure, say, 50 acres of this better-class soil will find that he can crop it profitably, " keeping the pot boiling " while he tackles the poor adjoining uplands.

The lime-requirement of the soil at the Puwera area, as determined by the Chemistry Section of the Department, is 3 tons of carbonate of lime per acre on the lower and 2 tons per acre on the higher lands. As with most of the North Auckland soils, heavy applications of lime, theoretically, should be applied to correct acidity as a necessary preliminary to any cropping. Just how far theoretical prediction in a matter of liming is verified in field practice will be dealt with later on. As would be expected, the soils are naturally badly drained, this applying even to the upland slopes. The retentive nature of the clay accounts for this.



SKETCH-PLAN OF PUWERA EXPERIMENTAL AREA.

The area comprises Section 140, part of Otaika Kauri-gum Reserve Extension No. 2, Maungatapere Parish, Whangarei County.

In getting the kauri-gum the digger left the surface over which he worked very rough; he did not fill in the holes that he made: hence we find the surface so uneven that it is necessary before putting teams on the land to refill these holes. Moreover, the holes, being made in a very retentive soil, filled with water, which formed pools in which rushes, algæ, and suchlike found congenial conditions for growth. It

will thus be observed that to break in these lands one must first face the legacy left by the gum-digger, who not only left an uneven surface, but also increased the natural sourness of the soil by interfering with the surface run-off of rain-water. This preliminary work, of course, increases the cost of breaking in the land.

The writers of this article took over the Puwera area in October, 1919. It had been established some years previously and certain grassing trials carried out (in what is now Field 6), but the chief work was confined to small plots in the nursery. In the accompanying sketch-plan the nursery is marked "Field 1." Here cereals, grasses, and fodder plants were tried to determine their suitability or otherwise to the soil, climate, and other local conditions. As an indication of the further suitability or otherwise of such crops for field trial the nursery has proved of value, but it has very obvious limitations, and in itself is of little value to the farmer.

Briefly, the specific problem awaiting solution was to determine the most suitable and economic procedure of breaking in this pipeclay type of gum land. Several courses were open to us:—

(1.) To burn the existing growth, and surface-sow with a mixture of grass-seeds. If the surface had not been so rough this might have been possible. At Puwera without question this method would have proved a failure, and its efficacy on most of the gum lands is very much to be doubted.

(2.) To cut the native growth, burn, and fill in the holes, thereby clearing and rendering the surface more or less even; then to prepare by cultivation for seeding to grass, forage, or special crops.

The latter course was adopted. Our further problems then were, firstly, how to treat the soil so as to secure good tilth, and, secondly, to determine what preliminary cropping is best and most economical for incorporating the necessary humus that the soil lacks. If good mechanical texture can be secured and organic matter can be successfully incorporated in the soil—at the same time bringing the processes economically within the scope of commercial farming—then the gum lands of the worst type, as at Puwera, can be improved and utilized to the benefit of the settler and the State.

At this juncture it may be well to point out that the opinion is held by some of the forestry experts, thoughtful farmers, and others who have studied the question, that from the economic standpoint it would be better to devote these areas to forestry. However, our problem was agricultural, and this aspect of the question in regard to any future policy for the best utilization of the gum lands does not affect our present investigation. If the main consideration later is forestry the agriculturist could closely co-operate in matters of soil survey and demarcation.

Field Tests.

As the systematic agricultural investigation at Puwera needs a period of some years to arrive at conclusive results, it must be borne in mind that the following account of the writers' work only deals with a little over one year's operations.

Portion of Field 3 was tackled about the middle of 1919 by the late Mr. R. Rowan, then Fields Supervisor, Auckland. The gum-holes were filled in, the manuka cut and burnt, and the area ploughed upon

which the 1-acre plots are now set out. It was prepared for oats, but was sown late, and the weather turning out dry the crop failed. When the present writers took over the area, about the end of 1919, the portion now in plots was immediately reploughed, and a scheme of systematic drainage set out and commenced. With the object of securing tilth, five 1-acre plots were laid out on the land that had been ploughed and for all practical purposes fallowed (see sketch-plan). During the course of the long fallow of about twelve months the area was drained with fascines, using manuka secured near the creek below Field 3. A main ditch was opened that carried away the surface run-off and the flow from the covered fascine drains. Field-tiles are too costly for this class of land. The manuka for the fascines was secured near the creek, where, as stated previously, the soil is fairly good, and hence the manuka attains a height of 12 ft. to 14 ft.

THE FIRST PLOUGHING OF FIELD 3 AT PUWERA EXPERIMENTAL AREA, AFTER CUTTING AND BURNING OF MANUKA.

NOTE.—All subsequent illustrations in this article refer to the Puwera Experimental Area.

The following shows the treatment that each plot has received up to the time of writing:—

Plot 1.—September, 1919: Ploughed and fallowed. April, 1920: Ploughed between 4 in. and 5 in. deep, and subsoiled a further 4 in. (the two operations were done simultaneously, the subsoiler being attached to the plough). Disked twice—before and after liming. One ton of ground burnt lime applied towards the end of the month. 7th September: Sown, in 7 in. drills, with Algerian oats 2 bushels, and spring tares 1 bushel. Manure (applied with seed), basic superphosphate 2 cwt., blood and bonedust $\frac{3}{4}$ cwt. The condition of the soil on this plot before sowing showed that very fair tilth had been

secured. The tares before ploughing down attained an average height of 3 ft. 6 in., but the oats did not do so well. The soil is now in good tilth.

Plot 2.—Received similar preliminary cultivation and liming to plot 1. On 9th November, 1920, it was sown with 12 oz. of Purple-top Mammoth turnip-seed in drills 14 in. apart. Manure mixture, basic superphosphate 1½ cwt., bonedust 1½ cwt. The plot yielded 20¼ tons of turnips. These were fed off to sheep and cattle.

Plot 3.—Similar treatment to plot 2, but the variety of soft turnip used was Devonshire Greystone. The crop yielded 26 tons 2 qr. 24 lb. of turnips. As regards tilth, plots 2 and 3 compared equally with plot 1. The turnip crops were particularly good. Individual roots weighed 14 lb.

Plot 4.—The same preliminary cultivation was given as to plots 1 to 3, but a greater quantity of lime was used. Burnt lime, 1½ tons, was applied in April, 1920, and in the last week of July a further 1½ tons. 10th September: Sown with 3 lb. broad-leaved Essex rape and 6 oz. white mustard. Manure, basic superphosphate 1½ cwt., blood-and-bone 1½ cwt.

Plot 5.—This is the check plot. It was not subsoiled, nor was any lime applied. 7th September, 1920: Sown with 2½ bushels Algerian oats. Manure, 2 cwt. of a proprietary special oat-manure. This plot was treated as nearly as possible to the average procedure common in the North—namely, plough, let lie fallow for some months, then take off oats for chaff, and seed to grass for permanent pasture, using the best English grasses, including ryes and cocksfoot. The crop on this plot (5) was too short to cut for chaff, and it was therefore cut with a mower and made into hay.

It may be mentioned at this stage that after plots 1 and 5 were ploughed up early in the present year fifty-three sheep were put on the turnips on plots 2 and 3, and the rape and mustard on plot 4. At the time of writing they are grazing on the plots, together with forty head of cattle that were put on later.

The cost of preliminary treatment of the 5 acres was as follows:—

	£	s.	d.
Cutting manuka scrub, labour seven days at 10s. per day	3	10	0
Filling in gum-holes, seven days and a half at 10s. per day	3	15	0
First ploughing, five days and a half at 10s. per day, £2 15s.; three horses at 5s. per day per horse, £4 2s. 6d.	6	17	6
Second ploughing, five days at 10s. per day, £2 10s.; three horses at 5s. per day per horse, £3 15s.	6	5	0
Disking, five days at 10s. per day, £2 10s.; three horses at 5s. per day per horse, £3 15s.	6	5	0
Liming, three 1-acre plots at 1 ton each, £6 7s. 6d.; one plot at 3 tons, £6 7s. 6d.; carting, sledging, and spreading, £4 4s. ..	16	19	0
Drainage, sixteen days at 10s. per day, £8; fourteen days at 14s. per day, £9 16s.	17	16	0
Rent of 5 acres of land (fenced), valued at £10 per acre, at 5 per cent...	2	10	0
Total	£63	17	6

Average per acre plot, £12 15s. 6d.

Plot 4 was the best as regards tilth. We would advise the heavier dressing of lime; although adding to the cost of breaking in, it appears at present that the vastly improved tilth compensates for the extra outlay.

THE MAIN OPEN DRAIN IN FIELD 3, WITH LATERALS OPENED TO RECEIVE FASCINES.

MAKING THE FASCINES FOR LATERAL UNDER-DRAINS.

If it is considered that this type of land can be put into good tilth from the virgin state for £12 to £13 an acre (including the cost of fencing—if unfenced it can be purchased at a considerably lower figure than we have allowed), then for turnips grown and fed off, followed by sowing to permanent pasture, the cost would be, according to our figures at the present time, from £10 to £12 per acre. We have allowed £1 17s. per acre for the cost of the turnip crop; at the yield secured we valued the turnips for costing purposes at £6 per acre; while £3 to £4 per acre would adequately cover the cost of sowing to permanent pasture.

It must be borne in mind that the work detailed above was carried out when the cost of materials was high, owing to the abnormal times. Further, it will be observed that included in the table are permanent improvements, such as cutting and burning surface growth, refilling gum-holes, and drainage. The fascines should last at least ten years. Again, no further application of lime would be needed for at least two or three years. Working out the cost of the permanent pasture from the figures given, and having due regard for these considerations, the cost would, spread over ten years, average

DRILLING GRASS-SEED IN FIELD 5.

Note the good surface tilth from use of tine cultivator.

£6 to £7 per acre. This is exclusive of any top-dressing with manure that may be done, as the profit gained from utilizing the pasture would be set against such estimated outlay.

Some Facts and Experiences.

From observations made periodically on the plots during the course of fallow preparatory to any cropping the following facts are worthy of record:—

Value of Lime.—As already mentioned, soil-analysis, using the Hutchinson-MacLennan method of determining the lime-requirement, showed that an amount of 2 to 3 tons per acre of carbonate of lime was needed to correct the natural sourness of the land. While it was recognized that to make the soil suitable for plant-growth the lime would be beneficial, the chief reason for its application to these plots was to

ascertain if it would make the soil less sticky, therefore more friable, and hence make for better tilth. This anticipation was realized on plots 1, 2, and 3, which received 1 ton of burnt lime, the tilth secured being much better than that of the check plot. Plot 4, which received burnt lime at the rate of 3 tons per acre, offered a striking example of the value of burnt lime in securing better texture, as it stood out in marked contrast to the check plot and was better than either 1, 2, or 3. It is only necessary to mention the experience we had when the clod-crusher was put on the plots. On the heavily limed soil of plot 4 the clods broke down easily to a fine mealy condition, while on the check plot the clods mostly did not break, but were pressed into the soil by the weight of the implement. Combined with drainage, liming makes possible slightly earlier cultivation in the spring, and the soil can be worked later in the autumn before the winter rains set in, thereby lengthening the season of growth. This, as every farmer knows, is an important consideration.

PLOUGHING IN MUSTARD FOR GREEN MANURE IN FIELD 5, PREPARATORY TO GRASS PASTURE.

Arising out of our experience on these plots we have now set out a series of plots in Field 2, which is in fallow, to determine—(1.) The advantages, if any, of burnt lime over ground carbonate of lime to secure tilth. This would be considered axiomatic in most countries, but we want definite field evidence on the gum clays. (2.) The most profitable quantity to use to secure the desired result. Amounts of burnt lime—namely, ½ ton, 1 ton, and 1½ tons per acre rate—will be used on plots of ¼ acre in area, and alongside plots with equivalent amounts of carbonate of lime, as well as check plots receiving no lime.

Choice of Implements.—From experience since taking over the Puwera area we are of opinion that the disk cultivator can be overused. The disk used often to keep the surface loose pulverizes the stiff soil too

much, and when rains fall the surface sets hard on drying. We have found that the freer use of the spring-tooth cultivator, leaving small clods on the surface, thereby preventing the running together, gets the desired results.

Deep Cultivation.—If the subsoiling is done simultaneously with ploughing the cost is reduced. We cannot say conclusively at present, but we have reason to believe that the deep cultivation on plot 1 was a contributing beneficial factor in securing a good crop. It allows lime to penetrate deeper, and also helps to retain moisture. On plot 5 (check), which was not subsoiled, the crop was checked when the hot, dry weather set in. The roots could not get down as deeply as in the subsoiled plots.

Drainage.—From examinations made in the drained areas there is no doubt that the resulting condition of the soil was better than on the undrained portion. Parts where one was unable to walk without

A FARMERS' UNION FIELD-DAY.

Instructor demonstrating summer forage crops in Field 2.

bogging are now growing crops. Where manuka is available we would advise fascines rather than field-tiles, because of the cost of the latter. So far the drainage is quite fulfilling expectations. After heavy rains the drained soil was fit to be cultivated sooner than the undrained. This is an important consideration on the gum lands, as on other classes of land needing drainage.

Increasing the Humus.—Three courses were open to us as a solution of the problem of adding organic matter: (1) Spreading farmyard manure; (2) growing green crops and ploughing them in; (3) growing green crops, and after feeding them off ploughing in the aftermath and dung. While the first course was not practicable, we may mention

that we have seen old pig-paddocks on the gum lands put into grass, and the resulting pastures of rye-grasses, cocksfoot, and clovers have been very good; moreover, these English grasses are being maintained. Fish-refuse has produced the same result for another farmer near Riverhead. Course (2) does not appeal to the ordinary farmer, but nevertheless, in the case of quick-growing legumes and crops like mustard, it is practicable and, we believe, economical as well. The third method appeals more to the farmer. Both the second and third are now being investigated at Puwera in the acre plots upon which the initial cultivation trials were conducted. No comparative results of preparatory cropping are yet available, however, the trials having only been started in September of last year.

Summary.—Summarizing results to date, we would say that to get satisfactory tilth before sowing it is advisable to (1) break up the land by ploughing, preferably with a long-mouldboard plough in the autumn, giving twelve months' bare fallow; (2) lime heavily with quicklime; (3) late in the spring mulch the surface, using the spring-toothed cultivators freely as well as the disks; (4) during the fallow, drain (if necessary) with open ditches and fascines, using manuka for underdrains. Closed drains, where needed, should be at least half a chain apart. As to preparatory cropping, oats and vetches fed off and the aftermath ploughed in is good practice. Turnips, rape and mustard, and mustard alone, promise well in the trials now in progress at Puwera.

SWEDES GROWN IN FIELD 2.

Tests with Grass-seed Mixtures.

Prior to being sown down to pasture in the autumn of 1920, Field 5, 12 acres in area, was ploughed 5 in. deep and subsoiled a further 4 in., worked down, and carbonate of lime applied at the rate of 10 cwt. per acre, then sown with 12 lb. of white-mustard seed, 3 cwt. basic superphosphate per acre being drilled in with the seed. The mustard was

ploughed under when sufficiently matured (see photo, p. 265). After a further dressing of carbonate of lime the area was sown down to test various grass-seed mixtures and manures. On the whole of the eight plots there was a satisfactory take of grass, except in the wetter undrained depressions, and sheep have been depastured on the area since the spring. It is too early yet to say how the various mixtures and

MARROW KALE GROWN FOR SUMMER FORAGE IN FIELD 2.

This crop was sown on 3rd November, and the photo taken in February.

individual permanent pasture elements in the mixtures will behave under stocking. The first season's growth has been satisfactory. Some useful data are expected for guiding us in making up a pasture prescription for trial on the best tilth that can be secured by preparatory cultivation and drainage, also preparatory cropping if the latter warrants its economic inclusion.

Nursery-plot Results.

Results in the nursery indicate that cocksfoot with red clover does well here. Paspalum, brown-top, danthonia, yellow oat-grass, tall oat-grass, Poa nemoralis, Poa anceps, Wakeman's fescue, crested dogstail, Lotus hispidus ("angustissimus"), Lotus corniculatus, and sheep's burnet also thrive.

Serradella, grass-pea, and vetches do well, and are under further trial for green-manuring and pasturing. Lucerne is under trial in the nursery, and has done reasonably well there, particularly Peruvian. There is every indication that Sudan grass (*Sorghum halapense*) and the sorghums will have a useful place in the North. They are drought-resistant, and will grow successfully where maize will languish in the dry weather. It is essential to sow in drills to allow for summer cultivation. The sorghums and millets have done well on our plots. Marrow-kale and kohl-rabi have yielded very well.

At the Albany and Puwera areas, where kikuyu-grass (*Pennisetum longistylum*) is under trial, it has done very well. It should have a value on gum lands, as it grows quickly, giving a lot of leafage that is succulent. Reports from Africa and Australia show that it is relished by stock, and it is very nutritious. We have not had a sufficient area so far to feed it to stock, but before the winter sets in it is hoped to feed off a plot.

As regards turnips, the following tables show results obtained last year on small plots, worked out to show approximate per-acre yields.

THE NURSERY (FIELD 1) VIEWED FROM FIELD 6.

The low hill in the middle distance is typical of the surrounding gum lands.

In order to test the varieties they were allowed to remain in the ground until 4th May, although some varieties were ready to be fed to stock at the end of February.

	Roots. Tons.	Tops. Tons.	Total Weight. Tons.
Pilkington's White Stubble Stone ..	10·36	3·63	13·99
Pilkington's Green-top Aberdeen ..	12·59	1·40	13·99
Pilkington's Purple-top Mammoth ..	19·04	2·51	21·55
A 1 Devonshire Greystone	15·43	2·74	18·17
A 1 Purple-top Mammoth	14·41	2·46	16·87
A 1 Purple-top Aberdeen	12·10	2·03	14·13
A 1 Imperial Green Globe	14·32	3·13	17·45
Yates's Green-top Aberdeen	11·61	2·12	13·73
Yates's Imperial Green Globe	13·77	2·11	15·88
Yates's Purple-top Aberdeen	12·42	2·45	14·87

TOBACCO-GROWING ON GUM LAND.

Tobacco is being experimented with at the Albany Experimental Area, but we are not yet in a position to report definitely, as the trials were only commenced this season. Dark and light varieties in cigar and plug tobacco all require special soils and treatment. There is perhaps no crop so susceptible to soil-influence as tobacco. Where there is a fair proportion of clay, as on the medium to heavy gum lands, the darker leaf could be grown. For the successful cultivation of this

crop, where the quality of the leaf rather than yield is of paramount importance, it is obvious that a good deal of knowledge and skill is required on the part of the grower. Tobacco-growing is one of the most advanced forms of agriculture.

Pending more complete results from the experiments at Albany, the writers can state conclusively that from crops examined on settlers' farms around Henderson and in other districts where the more friable gum-land soils were used good-quality leaf of the lighter varieties has been successfully grown. In every case the settlers were experienced tobacco-growers.

At Albany two insect pests made their presence felt in the tobacco this season. The young seedlings after transplanting were attacked by a cutworm, identified by the Department's Entomologist as *Agrotis*

ROOT-VARIETY TESTS: WEIGHING TURNIPS ON PLOTS IN FIELD I.

ypsilon. The large leaves were later attacked by a grub—one of the *Tortrix* genus. The small grubs eat the tissue between the upper and lower surfaces of the leaf.

Tobacco-growing may in the future play an important part in the development of gum land, and provide a lucrative source of income while pasture and more permanent crops are being established.

CONCLUSION.

There is evidence from Press notices, visits of farmers to the Puwera and Albany areas, and inquiries for advice received, that farmers are now showing much greater interest in the development of the gum lands. During the week ended 12th March this year eighty farmers and a number of high-school scholars were shown over Puwera by the writers. It must be borne in mind, however, that while results to date are encouraging, more complete and reliable data can only be obtained after

continuing the trials for a number of years. Then variable factors, such as season,* soil, seed, and the like, that may produce probable error, can be accounted for before arriving at definite conclusions.

The foregoing must be regarded as an initial account, and the intention is to publish from time to time further results of the work achieved. We, of course, recognize that a good deal of systematic work has been carried out on the northern gum lands by progressive individual farmers. There is, however, an absence of data or complete records concerning their work—a fact which largely discounts its value.

* The rainfall at Whangarei for the year 1919 was 42·32 in., and for 1920 75·50 in. The latter total, though high, was not well distributed, there being a dry spell in the spring, which affected the turnips and other crops then in the ground. The average annual rainfall is 56 in. These figures were kindly supplied by the recorder, Mr. Lionel Hanlon, of Whangarei. At our request the Government Meteorologist (Mr. D. C. Bates) has now established a rainfall-recording station at the Puwera Experimental Area.

LEMON BROWN-ROT AND ITS CONTROL.

A. H. COCKAYNE and G. H. CUNNINGHAM, Wellington.

LEMON brown-rot (*Pythiacystis citrophthora* Smith and Smith) was first recorded in New Zealand in 1907, from the vicinity of Auckland, where it was collected on lemons by Mr. W. A. Boucher, who in the previous year when on a visit to California had become acquainted with the disease there. At the time it was thought to be restricted to the Auckland District, and to have been then quite recently introduced in lemons from California. The disease, however, was recorded from all the lemon-growing districts of New Zealand as far south as Nelson within a couple of years of its first discovery here, and it is more than probable that the disease existed in New Zealand long before it was first discovered here in 1907.

The disease was first described and named by the two Smiths, in 1906, having only been noticed for two or three years previously in packed lemons in California. At that time, owing to the great amount of scale infestation of lemons with accompanying black honeydew fungi, it was necessary to wash all lemons prior to packing and curing. The water used for washing becoming contaminated with the swimming spores (zoospores) of the lemon brown-rot fungus, wholesale infection of the treated lemons followed, and huge losses were experienced through the rapid rotting of the fruit. This led to a full investigation being made, and it was found that the fungus was regularly present in the lemon-orchards, both on the fruit and stems, but that the actual orchard losses were small compared with the damage experienced after picking. It is therefore possible that the disease may have been present for many years in California, and have been either overlooked or confused with other diseases until the heavy loss experienced in the washing-sheds through the wholesale contamination of the washing-water was experienced.

At the present time the disease appears to be more or less on the increase in New Zealand, and a considerable amount of damage is

experienced in citrus-orchards, both by the actual destruction of fruit while on the trees and the killing of laterals and even larger branches. The special conditions necessary for the production of fruiting bodies of this fungus, and its inability to cause general infection when these conditions are eliminated, render the disease comparatively easy of control, and the general adoption of the necessary preventive measures should reduce any damage to a minimum.

Although in New Zealand the disease has been found only on lemons, in America it has also been recorded on almonds, apples, cherries, peaches, and pears.

APPEARANCE OF THE DISEASE.

In the orchard the disease first becomes noticeable by the presence of small groups of dead brown leaves, which appear in marked contrast to the healthy olive green of the normal leaves. On the young laterals small brown dead areas, which do not show as distinct cankers but remain flush with the surface of the normal cortex, are developed. On these attacked laterals all the leaves turn brown and become brittle and die, but remain hanging on the tree.

The first stage of infection on the fruit is a brown, somewhat sunken spot, which rapidly spreads until the whole fruit is of the same rusty-brown colour. Infected fruits become somewhat softer to the touch than normal fruits. When cut open a peculiar pungent smell becomes noticeable. This smell is peculiar to the disease, and is a ready means of determining, in the orchard, the presence of the trouble. Once the smell has been experienced it cannot be readily mistaken for any other odour.

LIFE-HISTORY OF THE FUNGUS.

The fungus *Pythiacystis citrophthora* is quite a primitive one, and is closely related to the well-known "Irish blight" of potatoes. It differs in several features, but particularly in its not forming oospores (spores produced as the result of conjugation and capable of resting throughout the winter). The fungus is normally a soil organism living saprophytically on decaying vegetable matter, and it is probably quite widely distributed in many soils quite irrespective of whether they are devoted to lemon-growing or not. It can thrive only in the presence of moisture, and fruiting bodies are produced only when an excess of moisture is present. For example, although fruit while on the trees, leaves, and branches may become easily infected in the manner to be described, no fruiting bodies are ever produced from the lesions on the branches or from those on the fruit while they remain on the tree. If infected fruit, however, falls to the ground and the soil is sufficiently wet the whole fruit and surrounding soil may become covered with hyphæ bearing the fruiting bodies (sporangia) of the fungus. These sporangia open at the apex and discharge a large number (in this species about thirty) of minute bodies known as zoospores, which are provided with two ventral flagella. With these flagella they move rapidly about, but only in the presence of moisture. Zoospores are the active agents in the spread of the disease on the trees. If branches happen to be pressed down on or near the ground, these organisms may readily be carried on to the foliage by being splashed up along with soil-particles from the soil during heavy rain. Again, whenever the leaves become covered with a film of water these zoospores may

readily swim from place to place in this film and become distributed over the trees.

After a time the zoospores settle down, lose their flagella, and, if they are in a suitable place, germinate and produce a long thread-like tube (hypha), which penetrates the cuticle and epidermis of the leaf or fruit. Inside the leaf or fruit this primary hypha branches repeatedly, and quickly spreads through the internal tissues, absorbing their cell-contents and so causing them to turn brown and die. Further infection could occur if these infected fruits were picked and packed in the case with normal fruits. If this is done the hyphæ grow out from the infected fruit and into the tissues of any healthy fruits with which they may be in contact. Other than by spreading in this vegetative method the fungus in the diseased fruit or limbs of the tree is unable to cause further infection until it becomes associated with an excess of moisture, and sporangia are thus enabled to be produced. Every lesion developed on the twigs and every lesion on the fruit while on the tree is due to infection by zoospores that in every case have been developed in sporangia produced either from the fungus in the soil or from fallen infected fruit. In no case can zoospores be developed on the tree itself or on the fruit while still attached to the tree. Thus the whole method of control is concerned either with the elimination of conditions that render sporangial development possible on the soil, or with the prevention of the transference of zoospores from the sporangia to the tree.

CONTROL MEASURES.

From a consideration of the life-cycle of the fungus it can be seen that three factors are essential in its spread :—

(1.) The presence of excessive moisture, so that sporangia may be developed.

(2.) Some method whereby the zoospores produced in the sporangia from the fungus on the soil or from infected fallen fruit lying on the ground may be carried on to the tree.

(3.) Direct contact of infected fruit with healthy fruit to spread the disease while in store.

It will be seen that if the first two factors are eliminated complete immunity to the trees is secured, and no fruit-infection can take place either prior or subsequent to picking.

In the summer months it is a simple matter to ensure that the surface soil shall remain dry. To effect this thorough cultivation should be carried out immediately beneath the tree. By so doing a dry area of 2 in. or 3 in. of soil is formed. As the fungus can thrive only in a moist soil, reproduction is prevented absolutely if this method is adopted.

In winter, however, it is impossible to maintain this dry zone, and prevention of the formation of zoospores becomes out of the question. Satisfactory methods of preventing the zoospores gaining access to the tree are therefore necessary. Two such methods are adopted generally in California, and they have been shown to be equally applicable and efficacious in New Zealand. The first method to adopt is the cutting-out of all laterals and branches that are in contact with the ground. Furthermore, it is advisable to remove all growth that is in any danger of being spattered when rain is falling. A safe practice, therefore, lies

in the cutting-out of all growth to a height of 2 ft. above the soil. This method serves a dual purpose, as it greatly facilitates the work of cultivating under the trees, as well as preventing the zoospores readily gaining a lodgment on the leaves and branches.

A second control-method adopted is that of cover-cropping the ground during the winter. Such a crop, by acting as a "blanket," entirely prevents the upward carriage of zoospores by means of rain splashes. Moreover, cover-cropping is often of great value from a manurial aspect when the material is ploughed under in the spring. Although in California great stress is laid on winter cover-cropping for the control of lemon brown-rot, there is not in many cases any necessity to do so in New Zealand. It frequently happens that under ordinary conditions quite a sufficient weed and grass cover is developed during the winter, especially in the North Island, to obviate any special crop being grown. If, however, it is considered necessary to grow a special winter cover there is a considerable range of crops to select from. In the Auckland and Tauranga districts Lotus hispidus (generally sold under the name of Lotus angustissimus) is by far the best crop for the purpose. From 6 lb. to 8 lb. of seed per acre is required, costing somewhere in the vicinity of 10s., which makes it one of the cheapest cover-crops that can be grown, with the exception of certain of the cereals, such as oats. Moreover, when once sown enough self-seeding generally occurs to obviate any additional sowing in the following years. Farther south Lotus hispidus does not grow sufficiently rapidly in the winter to form a very effective cover, and some legume, such as vetches or perhaps crimson clover, is generally suggested. In California the main cover-crop grown in connection with lemon brown-rot is King Island melilot (*Melilotus indica*), but its use is not advocated for New Zealand conditions. Provided the soil is reasonably fertile there is no better and cheaper cover-crop than Western Wolths rye-grass, using 1 bushel of seed per acre. It has the great advantage of forming an efficient and not too tall-growing cover, even when sown late in the autumn, and is very easily turned in in the spring. Great emphasis is generally given to the nitrogen-gathering character of the legumes, but the value of this feature can easily be overestimated in most New Zealand lemon-orchards.

So far as transit loss after the lemons have been picked is concerned, this should never be serious provided the methods for controlling the disease in the orchard are followed out. If at the time of picking there happens to be any infected fruit on the trees care should be taken to avoid including any with the fruit that is being marketed.

The lemon brown-rot fungus may occur in certain soils to a depth of 3 ft. or more, so that any method of soil-treatment is not feasible. Again, spraying the trees is not effective, as the disease is likely to spread most rapidly just when fungicides are least effective—namely, immediately after heavy rain.

The methods of control which have been here outlined do not interfere in any way with the general practices of lemon-growing, and have been found perfectly satisfactory. Being directly correlated with the distinctly vulnerable points in the life-history of the organism, they are logically sound, and emphasize the importance of a thorough knowledge of the ecology of any plant-disease before really satisfactory methods of control can be formulated.

IMPORTATION OF FERTILIZERS.

ANNUAL STATISTICS AND REVIEW.

B. C. ASTON, F.I.C., F.N.Z.Inst., Chemist to the Department.

STATISTICS of artificial fertilizers imported into New Zealand during the year ended 31st March, 1921, are now available (by courtesy of the Comptroller of Customs), and have been specially compiled for the *Journal* in the accompanying tables. Reviewing these returns there are several points of interest which call for comment and well merit the attention of readers of the *Journal*.

In round figures the gross quantity of fertilizers imported shows the great increase of about 60,000 tons over the figures for the previous year, the actual figures being 142,357 tons, against 80,833 tons. The fertilizers imported were chiefly phosphates of various kinds, and although the other two classes of fertilizers, the potassic and the nitrogenous, show large increases, the amount of these relative to the total is very small, being about 5½ per cent.

Considering the phosphatic fertilizers, it will be seen that basic slag is now coming to hand in quantities which show that in spite of the high price there is still a great demand for it. A notable feature of these slag imports is the re-entry of Belgium, France, Luxemburg, and Holland into the New Zealand trade. From Belgium came 4,500 tons, France 75 tons, Luxemburg 1,000 tons, and Holland 300 tons. In fact, New Zealand received more slag from the Continent of Europe than from Great Britain (which sent about 5,000 tons).

It will be interesting to watch the result of the competition which will result between basic slag and other finely divided insoluble phosphates, such as ground high-grade Pacific phosphate, when this is available in as finely ground a state as slag. A superiority of phosphate rock over slag lies in the fact that there need be no anxiety as to its poisonous nature, whereas a recent research indicates that animals grazed on recently slagged pasture may be poisoned by the particles which cling to the plants eaten. Until there has been sufficient rain to wash the slag from the grass stock should not have access to recently dressed land. When we consider that both slag and ground phosphate rock have their phosphate in the state insoluble in water, but that whereas slag only contains 16 per cent., Nauru phosphate contains some 40 per cent. of anhydrous phosphoric acid, it is difficult to believe that any superiority in the solubility of slag phosphate in the soil water cannot be counterbalanced by fine grinding of phosphate rock. This opinion applies, of course, to just those conditions of soil and climate which would indicate success in the application of basic slag—namely, for top-dressing old pasture in districts (1) where the soil is not too dry, in a moist climate with a well-distributed rainfall; (2) where the soil requires a phosphate fertilizer; and (3) where leguminous plants, especially white clover, are present in the pastures.

The next cause for congratulation one sees is the greatly increased quantity of superphosphate received—41,000 tons, as against 16,000 tons in the previous year. Superphosphate certainly has its place in the present system of New Zealand agriculture, and when it cannot be

obtained production of winter feed in all districts and of all crops in districts drier than the average must suffer. How far superphosphate can be replaced by finely ground phosphate rock is, of course, a matter for experiment in the field.

It is interesting to notice that those ports serving the drier districts of New Zealand receive superphosphate in much greater proportion than insoluble phosphate. Thus Napier, supplying the driest district in the North Island, imported 1,200 tons of superphosphate, but only 200 tons of insoluble phosphate; whereas New Plymouth, on the wetter west coast, received 2,500 tons of superphosphate, as against 4,000 tons of insoluble phosphate. Lyttelton, supplying a district drier than the average in the South Island, took 6,000 tons of superphosphate, compared with 3,500 tons of insoluble phosphate; whereas Invercargill, supplying a very moist area, received only 4,000 tons of superphosphate and 7,000 tons of insoluble phosphate. The figures for Wellington, Auckland, and Dunedin may also be given, although at the two latter places is manufactured a certain quantity of superphosphate, which would modify the conclusions to be drawn from the figures. The latter are as follows: Wellington, 9,500 tons superphosphate, 11,000 tons insoluble phosphate; Dunedin, 800 tons super, 13,000 tons insoluble; Auckland, 14,000 tons super, 42,000 tons insoluble.

A point most worthy of notice is the very great increase in the amount of rock phosphate imported over that for the previous year, the figures having bounded from 39,000 tons to 70,000 tons. The writer is strongly of opinion that this is the best form in which to purchase phosphate, provided that it be used in a condition which will compare in fineness with basic slag: at least 80 per cent. of the phosphate should pass a 10,000-mesh sieve. Any one particularly interested in the matter should consult previous articles in the *Journal* dealing with phosphates (Vol. 8, pages 1 and 115; Vol. 10, page 495; Vol. 11, page 111; Vol. 18, page 79; Vol. 21, page 37—the last two especially.

The method advocated by the writer of economizing phosphate by applications of lime has been tested on a piece of land which had been heavily manured with phosphate in the past. It is a matter of common practice in the Waikato to manure heavily with phosphate year after year. The writer suggested that the necessity for this was due to the fact that the phosphate of lime was being converted in the soil into phosphates of iron and aluminium, which in the absence of lime would be comparatively unavailable. It was suggested that by appropriate liming the reversion of phosphate to this form could be prevented, or that when it had taken place the phosphate of iron or alumina could be reconverted to the calcium compound.

In the experiment referred to (conducted by the Manager of the Ruakura Farm of Instruction) the control plot only gave 1 ton 10 cwt. of hay per acre, whereas the plot limed with a ton of ground burnt lime yielded 2 tons 8 cwt. of hay, as compared with 2 tons 9 cwt. given by Ephos phosphate (3 cwt.), and 2 tons 5 cwt. by 1 ton of ground carbonate of lime. Such data as these make one seriously consider whether much of the phosphate applied to the northern lands is not being wasted by the absence of sufficient lime in the soil to ensure the maximum results.

Potash manures are for the first time since the war coming forward in quantity from Great Britain, France, and Germany, and will be available at a much more reasonable price than during the war.

SUMMARY OF KINDS, QUANTITIES, AND DECLARED VALUES OF FERTILIZERS IMPORTED DURING YEARS ENDED 31ST MARCH, 1920–21 AND 1919–20.

Fertilizer.	Weight.		Value.	
	Year 1920–21.	Year 1919–20.	Year 1920–21.	Year 1919–20.
	Tons.	Tons.	£	£
Bonedust	4,440	6,272	65,183	66,412
Bone char	1,033	825	7,710	4,889
Bone-and-blood	256	288	4,864	3,897
Basic slag	10,823	2,759	104,428	15,852
Egyptian basic phosphate	10,810	15,000	76,186	77,000
Superphosphate	40,731	15,842	260,542	88,120
Guano and rock phosphate	70,208	38 861	186,690	90,812
Potash	1,143	65	18,459	2,054
Gypsum	1,381	..	2,908	2
Sulphate of ammonia	835	67	28,209	1,869
Nitrate of soda	564	135	11,525	3,816
Sulphate of iron	55	8	593	109
Manures unspecified	78	711	831	3,859
Totals	142,357	80,833	768,128	358,691

NOTE.—With regard to the "declared values" given above, the Comptroller of Customs supplies the following explanation: "The value for duty is defined as the fair market value in the country whence the goods are imported, plus 10 per cent. As the addition of 10 per cent. does not nearly cover the present freight, insurance, and other charges, the statistical value is a long way less than the actual landed value."

DECLARED IMPORT VALUES PER TON OF CHIEF PHOSPHATIC AND SOLUBLE NITROGENOUS FERTILIZERS FOR 1920–21 AND 1919–20.

	Year ended 31st March, 1921.	Year ended 31st March, 1920
	£ s. d.	£ s. d
Bonedust	14 13 7	10 12 0
Basic slag	9 12 11	5 15 0
Egyptian phosphate	7 0 11	5 2 8
Superphosphate	6 7 11	5 11 0
Guano and rock phosphate	2 13 2	2 7 0
Nitrate of soda	20 8 8	28 5 0
Sulphate of ammonia	33 15 8	27 18 0

IMPORTS OF THE PRINCIPAL PHOSPHATIC FERTILIZERS FROM 1911 TO 1921.

Year ended 31st March.	Bonedust.	Basic Slag.	Superphosphate.	Guano and Rock Phosphate.	Ephos.
	PRE-WAR IMPORTS.				
	Tons.	Tons.	Tons.	Tons.	Tons
1911	11,058	8,670	27,442	15,963	Nil.
1912	10,799	16,227	32,567	22,050	,,
1913	9,281	20,133	32,964	25,033	,,
1914	6,578	30,350	41,582	22,093	,,
	WAR AND POST-WAR IMPORTS.				
1915	7,966	29,385	54,190	23,983	Nil.
1916	10,059	10,339	58,013	39,366	2,026
1917	10,386	6,660	31,962	24,993	8,614
1918	6,363	10	37,157	37,037	11,225
1919	3,468	Nil	21,400	31,351	Nil.
1920	6,272	2,759	15,842	38,861	15,000
1921	4,440	10,823	40,731	70,208	10,810

IMPORTATION (IN TONS) OF PRINCIPAL ARTIFICIAL FERTILIZERS FOR YEAR ENDED 31ST MARCH, 1921, SHOWING COUNTRIES OF DEPARTURE AND NEW ZEALAND PORTS OF ENTRY.

New Zealand Port of Entry.	Australia.						Chile.	India.	Japan.	Pacific and Indian Ocean Islands.		United Kingdom.				Egypt.	Belgium.	France.			Luxemburg.	Netherlands.	Germany.
	Nitrogenous Manures.	Bonedust, Blood-and-bone, and Bone Char.	Superphosphate.	Rock Phosphate and Phosphate unspecified.	Gypsum.	Iron Sulphide.	Nitrogenous Manures.	Bonedust.	Superphosphate.	Name of Islands.	Rock Phosphate.	Nitrogenous Manures.	Basic Slag.	Rock Phosphate and Phosphate unspecified.	Potash.	Basic Phosphate.	Basic Slag.	Rock Phosphate and Phosphate unspecified.	Basic Slag.	Potash.	Basic Slag.	Basic Slag.	Potash.
Auckland ..	176	3,231	14,288	1,965	1,200	..	303	650	..	Makatea ..	26,566	12	2,648	36	75	3,000	2,950	100	75	430	500	300	220
										New Caledonia ..	4,704												
										Gilbert and Ellice	4,000												
Napier ..	..	..	1,213	200	..	..	..	..	..	Nauru	4,900												
										..	..	..	..	..	..	..	..	..	..	..	..	..	..
New Plymouth ..	..	..	435	485	..	..	..	..	1,942	New Caledonia ..	2,443	..	1,200	..	..	..	..	..	..	..	..	..	26
Wanganui ..	..	..	..	504	..	..	..	..	..	New Caledonia ..	816	..	..	..	..	..	..	..	..	..	..	..	35
Wellington ..	105	551	5,642	4,001	100	..	105	..	3,867	..	..	203	925	38	..	3,810	1,514	..	..	80	510	..	101
Nelson ..	..	..	..	25	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Lyttelton ..	5	..	1,084	1,611	75	25	..	..	5,200	..	..	50	..	..	..	2,000	125	..	..	10	..	..	10
Timaru ..	16	..	225	..	..	..	..	..	1,761	..	..	..	..	..	..	..	..	..	..	10	..	..	10
Dunedin ..	123	..	861	..	..	30	156	25	..	Makatea ..	8,584	50	..	..	..	..	..	..	..	80	..	..	..
										Gilbert and Ellice	4,414												
Invercargill ..	109	1,208	2,454	11	..	..	..	50	1,756	Makatea ..	4,066	..	..	..	..	2,000	126	..	..	75	..	..	..
										New Caledonia ..	777												

NOTE.—For the previous year's corresponding statistics see *Journal* of June, 1920, page 366.

SOME FODDER CROPS IN ENGLAND AND NEW ZEALAND.

HARPER-ADAMS COLLEGE EXPERIMENTS.

J. B. GARNETT, B.Sc., N.D.A., Christchurch.

[Paper read at the New Zealand Science Congress, January, 1921.]

ALTHOUGH the subject of fodder crops may appear at first sight rather hackneyed, I propose to deal more particularly with some aspects of the question illustrating the experience recently acquired at the Harper-Adams Agricultural College in Shropshire, where specialized work has been going on for some years in the growing of a succession of these crops and the feeding of them to dairy cattle. I will confine my remarks, however, to crops which seem to be specially suitable for New Zealand conditions.

But first there meets us the old question, is it worth the trouble of growing fodder crops in a country where grass grows so plentifully and over such a long period of the year? Now, it should be fairly obvious that in New Zealand fodder crops cannot compete with grass economically whilst the latter is plentiful, but that they are practically necessary for feeding dairy cows in the off seasons when the grass-supply is short. Mr. John Brown, late head of our own Fields Division, dealt at length with this question in his paper, "Factors affecting Methods of Farm-management in the North Island," published in this *Journal* for July, 1916, and he came to virtually the same conclusion. He says, "... the growth of grass is not continuous, whereas for profitable dairy-farming it is of the highest importance to maintain the milk-flow at its highest possible level from the beginning to the end of the season. This cannot be done on grass alone, and if specially grown crops were not available at times the milk-yield would be checked and would fail to make a satisfactory recovery with the subsequent freshening of the grass. ... I think a very small ratio of special-purpose crops to grass spells the highest economy."

However, under the present economic conditions this very small ratio of fodder crops to grass may well have to be narrowed, in all but the most favoured grass districts, in the interests of increased production. More especially to those who have had to take up smaller farms owing to the price of land, and have had to shoulder a big capital outlay per acre, a wider knowledge of the most suitable fodder crops would be of very great value. The large capital outlay that has lately been necessary to start a farm at once cuts out the older, more extensive methods of sheep and cattle ranching, and a more intensive system is necessary before even interest on capital can be realized.

In this respect fodder crops have been proved to beat grassland. For instance, in Shropshire, which is supposed to be a good grass county for England, and has a rainfall of 25 in. to 30 in., we kept just double the number of cows on the same amount of land growing fodder crops as when it was under pasture. Then, again, fodder crops are very suitable for districts with high rainfall where grain-growing is usually very precarious. Even if they are lodged or laid this in no way interferes

with their utility, and when it comes to silage-making they are superior in every way to grass. Further, in the drier districts they can be grazed off by cattle and sheep, and on the very light dry soils such as we get in parts of Canterbury this seems to be one of the cheapest and most practicable ways of increasing the vitally necessary organic matter in the soil. The English farmer improves such soils by carting out and spreading big quantities of farmyard manure, but this is economically impossible in New Zealand. Happily, the same result is obtained by forcing big leafy forage crops with artificial manures and then feeding them off with sheep or cattle. Lastly, amongst the advantages of fodder crops is that they are mostly leafy dense-growing crops, and are excellent for cleaning the land, particularly of such weeds as twitch and Californian thistle The cutting of the crop and subsequent breaking-up of the land help greatly in this cleaning process.

SOME HARPER-ADAMS COLLEGE CROPS.

I will now deal with some of the best crops and mixtures as grown at the Harper-Adams College :—

Peas and Oats.—This is an excellent mixture either for green feed or to be made into hay. It is usually much better than either crop grown alone, for the following reasons : I found by a series of careful sand cultures that oats grown with peas were about 15 per cent. heavier than those grown alone, and this seems to be chiefly due to the extra nitrogen obtained by the oats from the pea-roots growing alongside them. Apparently a leguminous crop will start supplying nitrogenous compounds to plants growing alongside right from the time its own roots get established and a sufficiency of nodules formed on them. Also, no doubt, as Dr. Brenchley has demonstrated at Rothamsted, oats and peas would enter less into competition with each other than oats and oats (pure oats).

The mixture makes a better-balanced feed than either crop alone. In Shropshire we could usually reckon on a 3-ton-per-acre crop of pea-and-oat hay on land which usually produced about 45 cwt. per acre of clover and rye-grass hay. A good deal of work was also done in finding the best varieties of both oats and peas to grow for the purpose, and eventually Dun oats and either Maple (Partridge) field-peas or Dun peas were found to be the best. However, for New Zealand conditions other varieties might be found to be more suitable. The seeding found to be best was 2 bushels of oats to 1 bushel of peas. A word of warning is here advisable, however, to New Zealand farmers. In districts of low rainfall and long dry summers peas grow very thin and spindly and bulk up very little, and so the usual oats and vetch mixture would be more reliable under such conditions. In the rainier districts I should like to see adjacent plots of peas and oats, and vetches and oats, respectively. These could be fed off by similar lots of sheep, and the live-weight increases obtained on each crop would be a reliable method of comparison.

We also found that well-got pea-and-oat hay was about the most valuable dry feed for milch-cows, and tended to counteract any scouring effects due to the cows eating too much succulent green fodder. The cows in full milk were usually getting 60 lb. to 70 lb. of green food and about 10 lb. of pea-and-oat hay per day, and if either was reduced in quantity the milk-yield usually fell the next day.

Rye-corn and Vetches.—This mixture was sown in the autumn. It is suitable for sowing on stubbles as a winter catch-crop. It makes a certain amount of growth during the winter (probably it would grow well through an average North Island winter) and comes into use early in spring, well before the grass becomes plentiful. It should be fed before the rye-corn comes into full ear, otherwise this cereal becomes very tough and unpalatable.

Mr. J. C. Brown, who has done most of this work at the Harper-Adams College, was also trying to breed a fodder wheat suitable for growing with vetches, and this might be usefully done for some of the drier Canterbury land where oats do not give much bulk of green feed, and wheat would have the advantage of its deeper root-system.

THOUSAND-HEADED KALE (ON LEFT) SCARCELY ATTACKED BY CABBAGE-APHIS, WHILE RAPE (ON RIGHT) HAS ALMOST SUCCUMBED TO THE PEST.

Photo taken on the agricultural plots in connection with the Christchurch Technical College.

Peas, Buckwheat, and Rape.—This very useful mixture was sown in the spring, and came ready with a big bulk of succulent greenstuff in the late summer, just when the pastures were all brown and bare—a state of things occurring in some summers even in England. The seeding per acre consisted of field-peas 1 bushel, buckwheat 1 bushel, and giant rape ½ lb.

Those farmers who have grown rape in New Zealand and had it badly blighted (overwhelmed with cabbage-aphis) would probably find that this mixture would give at least as good a yield as rape alone, and the rape-plants would not be attacked to the same extent as when grown alone. I have lately been on the lookout for rape-plants which might have a certain amount of resistance to this pest, but, although

undoubted differences can be detected in various plants in this respect, the best ones are eventually too far from being immune to warrant further selection. In extreme cases farmers might be well advised to sow Thousand-headed kale in the mixture instead of rape, as the former is very much more resistant to the cabbage-aphis. (This may be seen by the photograph on the preceding page, in which is shown a plot of Thousand-headed kale on the left scarcely attacked, and a plot of rape on the right which has almost succumbed to the aphis.)

Beans, Peas, Vetches, and Oats.—This is a second mixture which was sown in spring and also came in during the late summer when grass was scarce. The seeding per acre was as follows: Beans 1 bushel, Maple field-peas ½ bushel, vetches ½ bushel, Dun oats 2 bushels. Although this seeding might be rather too heavy for New Zealand conditions, yet for obvious reasons it is better to err on the heavy side in the seeding of forage crops.

Maize.—Usually a plot of maize was sown for fodder, but this only grew well about one season out of every three, whereas in the warmer climate of New Zealand it is much more certain. Our main fodder variety was Giant Caragua, which seems to give much the greatest bulk of leaf and stem, but it does not seem to be obtainable here. I may suggest that the testing of the heaviest-growing variety of maize and the subsequent growing of marketable quantities of the seed could be very suitably carried out at some of our experimental farms working in conjunction with the recently established Moa Seed Farm. Many of the most suitable varieties of crops for such special purposes are not grown here, and the farmers have to either make do with the "next best" or go to the trouble and expense of importing the seed from the other side of the globe.

OTHER HARPER-ADAMS FEATURES.

An unusual feature of the Harper-Adams system was that five-eighths of the total area under fodder crops produced two crops per annum. This was found to be possible by breaking up the land as soon as the earliest mixtures were cut and carted off, and planting cabbages which had previously been grown ready in a special seed-bed. The remainder of the land was cleared too late for double cropping that same year, but worked round in its turn for it the next year. Now, if double cropping is possible in England it should be easily workable in the warmer parts of New Zealand. These cabbages were consumed during the winter and early spring, and proved an excellent feed for milk-production.

One field of the experimental farm was devoted entirely to the growing of a constant rotation of fodder crops. The soil was a medium loam, and had previously been farmed under the ordinary Norfolk four-course system. It is very instructive to notice the effect on the soil as revealed by analysis made before the new method of cropping, and again after about three years under this system:—

	1914. Per Cent.	1919. Per Cent.
Loss on ignition	3·320	4·200
Nitrogen	0·122	0·213
Total lime (as CaO)	0·266	0·260
Phosphoric acid	0·100	0·105

Had all the crops been fed directly on the land the soil would have been enriched even more, as considerable losses are unavoidable in carting home fodder, making it into manure, and carting this back at intervals from a manure-yard. In New Zealand the crops would have to be fed directly off the land, as far as possible, in order to economize labour. This would result in greatly decreasing the impoverishment of the soil, which is inevitable where milk is being sold off the land year after year.

CONCLUSION.

In conclusion, I am sure there is still a lot of work to be done by our experimental farms in finding the best varieties and mixtures of fodder crops to grow, and the times to sow them, in order to get a bulk of greenstuff at those critical periods of the year. Having them at the right time makes all the difference between profit and loss to the grower and milk-producer. It is also necessary to bear in mind that in a country of such diversified soil and climate as New Zealand these problems must be worked out for each province. The economics of the question should be tackled on such definite lines as would settle finally the vexed question of "grass *versus* fodder crops."

PHORMIUM TENAX.

THE NEW ZEALAND FIBRE INDUSTRY.

ESMOND H. ATKINSON, Biological Laboratory, Wellington.

III. CONSERVATION AND CULTIVATION.

As has been mentioned in the first of this series of articles, the Maoris cultivated certain of those varieties of phormium for which they had names. For the most part, however, they relied for their supplies on the wild plant, and simply selected from the swamps whatever kinds they required. So far as is known, what little cultivation they did undertake was simply for the purpose of having immediately to hand some especially prized variety which was not to be found wild in the locality. No efforts were made by them in the direction of trying to improve the fibre by cultivation.

It was not to be expected that in the early days of the industry much would be done in the matter of the cultivation of phormium, which was abundant enough in the wild state to meet all demands, while the small amount of capital which was usually available was all required for machinery and working-expenses of the mill. Nevertheless, certain facts in regard to phormium must have impressed themselves upon those familiar with it, and no doubt suggested the possibilities latent in the cultivation of the plant, one being the occurrence of a large number of forms, varying greatly in habit, size, quality of fibre, and other respects, another being the remarkably stimulating effects of drainage on the growth of phormium-plants in swamps.

Early in the latter half of last century experiments in the cultivation of phormium were made by various individuals, in some cases on a fairly large scale, one area of 30 acres being planted near Wanganui, while another plantation of 25 acres in Taranaki contained 75,000 plants of the best varieties, but the outlay was too great and the prospects not promising enough to warrant the work being gone on with. At about the same time a portion of the Botanical Gardens in Wellington was set apart for the cultivation of phormium, but for various reasons the project was not carried out fully, and little was gained in the way of fresh knowledge.

Towards the end of the century, when the industry had reached a position of great importance, attention was again directed to the need for conservation, the millers beginning to realize that the apparently inexhaustible supplies of raw material were not really so, and that more scientific methods would have to be employed if the supply of leaf were to be maintained. The general advance in swamp management, which may roughly be said to have begun with the new century, was in two directions—namely, in the draining and cleaning-up of the swamps, and in the method of cutting the leaves.

THE DRAINAGE OF SWAMPS.

At first sight it may seem strange that a plant growing naturally in a certain station should be made to grow much more luxuriantly by changing some of the conditions obtaining there, but it must be remembered that phormium growing under virgin conditions shows its greatest luxuriance in rich well-drained alluvial flats (such as the mouths of rivers), and that its presence in a more or less stagnant swamp does not imply that the conditions most favourable to its full development are fulfilled there, but rather that it constitutes one of a succession of unstable plant coverings, and as such is liable to replacement by some other plant more suitable to the station. The artificial reversal of this process may be seen in the now universal practice of the removal of stagnant water from phormium swamps by a system of main drains intersected at necessary intervals by smaller ones. The advantage of this practice lies not only in the greater luxuriance of the phormium itself, but also in the replacement by it of such plants as raupo (*Typha angustifolia*) with the formation of an almost pure phormium association. The drains are open, and the water-level is 2 ft. or 3 ft. below the surface of the swamp. It is estimated that fully 50,000 acres have by this means been converted from unprofitable swamps into good phormium-producing areas.

In many cases, however, such plants as manuka (*Leptospermum scoparium*) and toetoe (*Arundo conspicua*), a large grass closely resembling pampas-grass, are active competitors of phormium in the reclothing of the areas left bare by the disappearance of the raupo, and considerable work has to be done in keeping them under control. In some districts, notably the big swamps of the Manawatu, tall fescue (*Festuca elatior*), a large introduced grass, must be added to this list of the weeds of phormium swamps. Blackberry (*Rubus* spp.) may also be mentioned, being sometimes particularly troublesome.

MAIN DRAIN IN A PHORMIUM SWAMP.

The estimated average cost of the maintenance of the crop in good condition is about 10s. an acre per annum, the work including the clearing-away of weeds and rubbish and the keeping of the drains in proper order.

Great as are the advantages gained by the draining of the swamps, so decided an alteration in the natural conditions has introduced several highly undesirable factors, the most important of which has been the enormous increase of certain insect enemies of phormium, which previously were negligible. This subject will be dealt with more fully in a future article of this series. The menace of fire has also increased with the removal of moisture from the floor of the swamps, which in summer becomes of extreme dryness, many thousands of tons of leaf having been lost in this way. The most effective safeguard against fires in phormium areas consists in lightly grazing them in the summer, the stock keeping down the undergrowth, which otherwise would die off and by the following summer form a bed of inflammable material.

In some instances the land when drained has proved to be of such great agricultural value that it has been more profitable to convert it wholly into pasture than to attempt to keep it in phormium.

CUTTING THE LEAF.

The Maoris had certain definite ideas in regard to the cutting of the leaves, the one most universally held being that no cutting should take place from the time of the first appearance of the flowering-stalk until its death. In support of this they maintained that during this period the fibre is brittle and red in colour. No experiments have been made to ascertain the truth of this statement, which is not borne out by the general practice of the miller, whose busiest time is from the spring to the autumn months. It has been observed, however, that in certain seasons which have been notable for the extremely prolific flowering of phormium the fibre has been more difficult to extract than usual, owing to its being somewhat woody in character, the reason for this apparently lying in the removal of the sap from the leaves to the rapidly growing flower-stalk.

The Maoris were probably not troubled by any consideration of possible damage to the young leaves by frost as a result of cutting in the winter, which is one of the reasons for the closing of mills in many localities during that period.

In the early days of the industry the cutting of phormium-leaves for the mill, like many other stages in the process of fibre-extraction, was carried out in the most careless manner, the whole fan being sliced off at the point from which the leaves spring. Later it was seen that this ruthless process had a most damaging effect on the vitality of the plant, besides including in the cut leaf a large amount of material valueless for fibre-extraction and liable to cause staining and discoloration. On recognizing this, some millers went so far as to refrain from cutting two or three of the leaves at the centre of each fan with the idea of ensuring a rapid growth of fresh leaves. This system, however, a reaction from the destructive methods of the early days, has not been generally adopted. In the opinion of Mr. A. Seifert, of Palmerston North, an annual cutting of the mature leaves only would be less damaging to the plant, and would, moreover, give a far higher yield of fibre. Mr. Seifert's opinion is based on the fact, which he has proved

by experiment, that the average life of a leaf is one year and nine months. This being the case, it is obvious that under the present system a large amount of leaf is lost to the miller. The extra expense involved by this more frequent and careful cutting would be avoided by planting the phormium in rows, and thus making each plant easily accessible.

The present practice is to cut the leaves across at a distance of from 6 in to 8 in. above the point of their insertion on the crown of the rootstock. It is found that cutting the leaf in this way does not unduly weaken the plant, and that under average conditions the same plant will have produced a fresh crop of mature leaves in from three and a half to four years, the former period being the recognized minimum interval to allow between two successive harvestings. A shorter period has been shown, as a rule, to cause too great a drain on the vitality of the plant, cutting all the leaves every two years, for instance, ultimately causing its death. In the case of exceptionally vigorous plants a biennial cutting might be possible, at any rate for some time, while, on the other hand, in some areas an interval of even four years is too short, both the vitality of the plant and the quality of the fibre derived from it being adversely affected.

The Maoris frequently used leaf not more than a few months old, but this was for special purposes requiring clean unspotted leaves from which a particularly fine and soft fibre would dress out. From the point of view of the miller, who requires a general-purpose fibre, immature leaf is unsatisfactory, being without the necessary body and strength.

Phormium swamps as treated at the present day will yield every three or four years about 25 tons of green leaf per acre in good areas, though up to 40 tons per acre has been cut in exceptional cases.

METHODS OF PROPAGATION.

Phormium may be grown by division of rootstock or from seed. The former method was the one exclusively used by the Maoris, who avoided the use of seed, since it could not be relied on to reproduce the characters of the plant from which it was gathered. A piece of rootstock bearing roots and crowned with a fan of leaves was separated from the plant, and the outside leaves cut off in a line sloping up from the base of the outside leaf on each side to the central shoot. The youngest or middle leaf was left uncut unless it was 3 ft. or so long, when it was cut off with the rest. Four of the pieces of rhizome thus prepared were planted together in well-worked soil, with the crowns outermost and inclining away from one another. This old Maori method, or some modification of it, is the one used in the planting of phormium on a large scale.

As is indicated by its great range of habitats, phormium is not particular as to soil, but rich alluvial swamp land, drained in the way already described, is that most suited to its best development as a commercial crop. The land should be ploughed in winter or spring, and planted in the autumn when the dry weather has broken. The plants will then make considerable growth during the winter and will come away strongly in the spring. They should be planted in rows from 4 ft. to 6 ft. apart, and the same distance should be allowed between two plants in a row. This will allow the plant to assume its

natural habit, and ultimately a solid stand of phormium will be the result. Cultivation between the plants is advantageous until they stool out sufficiently to cover the ground completely. Very little phormium has been grown in this way, the present area not exceeding 300 acres. The planting of phormium in the dune hollows which occur along so many parts of the New Zealand coasts, behind the actual sand-dunes, has been suggested by Dr. L. Cockayne in his report on the "yellow leaf" disease, and doubtless in this way large areas of now useless land could be turned to good account.

In raising phormium from seed, a bed is prepared in free sandy loam, the surface raked until it is fine and even, and marked in drills 1 in. deep and 18 in. apart. If the ground is very dry at the time of sowing it may be watered, and it should be kept moist in dry weather. The seed of phormium is ripe in the early autumn, and it is inadvisable to delay long in sowing it, June being perhaps the most suitable month for this purpose. It should be sown thinly and covered to the depth of ½ in. or more. Careful weeding is necessary, and if there is danger of frosts the seed-bed should be covered with brushwood. Spring sowing has proved a failure. Seedlings grown under these conditions should be ready for planting out into permanent positions in twelve months, and will take from six to eight years to mature, according to soil and climatic conditions. It is contended by some authorities that phormium-plants grown from seed are stronger in constitution than those obtained from division of the rhizome, while the initial cost is less. So little is at present known, however, as to which of the races come "true" from seed and which do not that to any one anxious to obtain a large number of plants of any particular type propagation by division is the more reliable method.

PHORMIUM AND THE PLANT-BREEDER.

Although the plant-breeder has as yet given but scant attention to phormium, very many varieties named by the Maoris are far above the average attained in an ordinary swamp, and from the propagation of the roots of any one of these a homogeneous crop, unapproachable by any obtainable from a natural area, could be produced. The question of the cultivation of races immune from disease is also a most important one.

Most of the work in connection with the cultivation of phormium that has been referred to has been that undertaken by millers, &c., whose chief aim has been the improvement of existing areas, and the establishment of new ones on a commercial basis, rather than any attempt to produce improved races by scientific methods. It is true that tentative efforts have been made from time to time, but how little had been achieved in this direction even after the industry had reached a position of great importance to New Zealand is shown by the fact that in 1906 Cheeseman, in his "Manual of the New Zealand Flora," wrote in his remarks on *Phormium tenax*: "Considering the economic importance of the plant it is singular that no systematic attempt has been made to collect the whole of the varieties and cultivate them side by side in one of the public gardens of the colony. Until this has been done it is practically impossible to describe them in a scientific manner. Isolated descriptions of a few without comparison with the rest would be of little use."

To collect and cultivate the various forms in this way would be an essential preliminary to a thorough scientific study of the plant, with the ultimate view of segregating and fixing races capable of producing almost any desired quality of fibre. Disease-resistance, rapidity of growth, high fibre-productiveness, easily stripped fibre, and immunity from insect attacks may be mentioned among other ideals to be aimed at. Work analogous to this is being carried out by plant-breeders all over the world, in many cases on plants far less promising than phormium, the economic possibilities of which, as the outcome of work on scientific lines, are enormous.

PHORMIUM AS A GARDEN-PLANT.

In concluding this part of the subject some mention must be made of phormium as a garden-plant. It is now extensively grown for ornament in the warmer parts of Great Britain, Europe, and America, races with variegated, bronze-coloured, or purple leaves being particularly prized.

WHITE SUGAR MANGOLD SELECTION.

THE selection of White Sugar mangold, commenced by Mr. W. S. Hill at Moumahaki several years ago, has been continued without interruption, and an excellent crop of this strain was secured at Ruakura last year, the yield being over 73 tons per acre. A further selection of 100 roots was made this season, and 25 lb. of seed has been harvested. The accompanying photograph shows the plot of mangolds

PLOT OF WHITE SUGAR MANGOLD FOR SEED AT RUAKURA.

in full seed. The protecting fence somewhat spoils the picture, but the height and strong growth of the mangolds can be seen.

During the farm school held at Ruakura last July the visiting farmers were so pleased with the weight and quality of this crop that they made repeated requests for seed, and as a result sacks of selected mangolds were distributed to twenty-seven of them for seed-production on their own farms.

—A. W. Green, Manager, Ruakura Farm of Instruction.

PLANT-BREEDING AT WERAROA.

SOME CURRENT NOTES.

J. BEVERLEY, Plant-breeder, Central Development Farm, Weraroa.

CLOVERS.

RUNCIMAN'S red clover has now been thoroughly tested, and may be regarded as the only truly perennial strain of red clover existing in New Zealand. It should prove of very great value in the Dominion, where there is a very great requirement for really perennial red clover in the pastures.

White clovers: In 1914 several selections were made in the Auckland District by the writer, and other selections a year later at Moumahaki. An interesting collection of different types was secured. Seed from these types was sown in comparative trial plots, as well as seed from

WERAROA WHITE CLOVER AT THE CENTRAL DEVELOPMENT FARM.

[*E. B. Levy, photo.*

several English, French, and Italian varieties. Lodino and wild white are the only two left of imported varieties sown in 1916. Recently one of these selections (B 95) was isolated. It was transplanted to its present position in October, 1919, and at the present time covers an area of 16½ square yards. It is to be known in the future as Weraroa white clover. Lodino white clover makes little growth here during the winter, while Weraroa white keeps moving, with an attractive appearance. It is also well furnished as regards size of leaf and seed-heads. Weraroa white clover, owing to its truly perennial character and great yield, promises in a few years to become the standard white clover for New Zealand.

GRASSES.

Moumahaki cocksfoot, which is a pure-line cocksfoot of undoubted merit, has now been seeded as a field crop, and a limited supply of seed for distribution will soon be available. Mention may be made that the parent stock has been grown on the Danish system, in rows 3 ft. apart, so as to allow intercultivation. For the last three years the yield has averaged 500 lb. to the acre, which clearly indicates that row sowing with intercultivation is the cheapest method of producing cocksfoot-seed.

Moumahaki prairie-grass has continued to show complete immunity to smut, and five acres are now being grown for seed purposes.

Poa laxa, which is a very broad-leaved and vigorous species, closely resembling Poa pratensis in other particulars, gives promise of being a very valuable permanent grass. As it has seeded freely this year a supply of seed for further trial work is available.

LUCERNE.

A yellow-flowered selection of Chermo lucerne, characterized by the abundant production of underground stems, is being grown at Weraroa on a comparative basis. It has every indication of proving of great value as a grazing lucerne, but up to the present the form has not been properly fixed.

PEAS.

Two varieties of peas, Weraroa Strategy and Weraroa Imperial, have passed out of the experimental stages this season. In a previous note in the *Journal* it was mentioned that the time would probably come when field and culinary peas giving more than a pair of pods on a stem would be introduced. This anticipation has come to pass, and numerous new types of peas are being worked at Weraroa. The principal new type is the pea giving two stems at a leaf-axil, bearing from two to three flowers each. In the past season one plant had thirty-one blooms at the first six flowering internodes. Another new type is a plant giving from three to five flowers on the stems fairly constantly. These types of peas are known as the triplet type, and work is proceeding to tripletize field varieties such as Early Minto, Egyptian, Partridge, and Weraroa Imperial.

Owing to the heavy winds in the spring at Weraroa, a pea which branches well at ground-level is desirable. For this reason 100 varieties of peas were grown in 1917 to ascertain the most suitable in this respect. Sutton's Late Green Marrow was undoubtedly the best, and was crossed the following year with a triplet pea. The most forward of these new types are now in the F 3 generation.

Fowl-manure for the Garden.—The best way to use fowl-manure is to collect the droppings daily and keep them under cover mixed with equal parts of dry soil. About 7 lb. of the mixture per square rod is a fair dressing. Neither lime nor wood-ash should be mixed with the droppings, as either material would drive off the ammonia, which is the most valuable constituent in fowl-manure.—*Horticulture Division.*

FRUITGROWING IN THE WAIKATO.

L. PAYNTER, Orchard Instructor, Hamilton.

THE accompanying photographs, taken in the orchard of Mr. J. McMiken, Hamilton East, show what can be done by proper care and attention along modern lines. The trees, which are six years old, are typical of those growing in this eight-acre orchard, containing apples, pears, peaches, nectarines, and plums.

The orchard is situated only a short distance from the Ruakura Farm of Instruction. The soil is variable, from light loam to a rather stiff heavy soil, having a subsoil of a corresponding nature. From the time of planting Mr. McMiken has grown root-crops among the trees. The trees came away with good growth the first season, and have continued to make excellent progress ever since. The pruning has been carried out each year on modern lines. Many of the trees commenced to crop even in the second year, and have continued to do so ever since. As the photographs show, this has not had the effect of retarding growth to any extent.

MUNROE'S FAVOURITE APPLE.

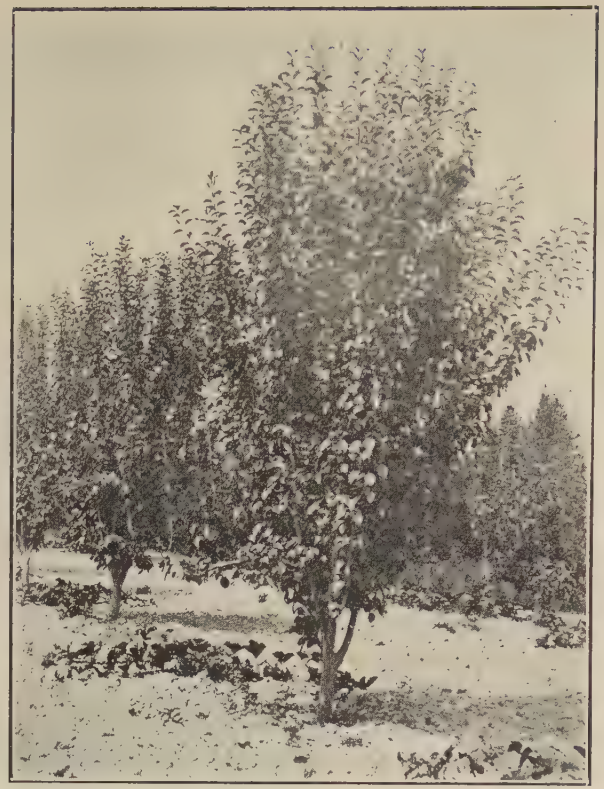
Six years planted; height, 12 ft.; crop, 5 bushels.

The orchard has been a profitable undertaking — probably there are few that have given such good returns. The Goldmine nectarine shown is typical of the whole of the peaches and nectarines, the trees yielding from fifteen to twenty-five cases per tree. The practice of growing root crops between the trees is an excellent one. The ground is profitably used during the lean years while the trees are becoming established, and the practice ensures the soil being kept in a state of good cultivation, instead (as frequently occurs) of being in a semi-neglected condition. The soil can be easily compensated for the plant-food taken out by the root crops.

It is unfortunate that Mr. McMiken is this year losing about one acre of apples and half an acre of pears through fireblight. These are all to be replaced with stone-fruit, chiefly peaches, for which there is a good demand in the Waikato at profitable prices.

GOLDMINE NECTARINE.

Four years planted; height, 15 ft.; estimated crop, 10 cases.



KEIFFER'S HYBRID PEAR.

Six years planted; height, 15 ft.; crop, 2 bushels (coming into bearing). So far immune from fireblight.

LUCERNE IN THE STANLEY BROOK AND TADMOR VALLEYS.*

F. W. GREENWOOD, B.A., Instructor in Agriculture, Wellington.

In the Stanley Brook Valley, which is drained by a stream of considerable size, one finds, quite contrary to expectation, that the soil along the banks of the stream is not a loose river-silt, but is, in most instances, composed of a stiff clay surface soil and a fairly impenetrable subsoil. Numerous efforts have been made to establish lucerne in the district, and, with the exception of a plot (Fig. 1) sown by Mr. S. Barker in 21 in. drills on a granite sand scoured out of an adjoining gorge, the above description of the soil on which the crops were sown may be said to be general in its application.

FIG. 1. MR. S. BARKER'S LUCERNE (WHEN THREE MONTHS OLD) SOWN ON GRANITE-SAND SOIL, STANLEY BROOK VALLEY.

From the outset prospective lucerne-growers were faced with several serious difficulties, which may briefly be summarized as follows: (1) The prolificacy with which weeds grew; (2) the great retentivity of the clay soil, causing stagnant water, one of the worst enemies of lucerne; (3) the stiffness of the soil, and the consequent difficulty of working it, (4) the close nature of the subsoil, which largely prevents lucerne-roots from striking deeply.

So far as one can judge from attempts made up to the present time, no completely successful method of keeping the weeds in check on any of the stands has yet been found. Taking full account of the unsuitable nature of the soil, many farmers have sown the seed in 21 in. drills with a view to employing intercultivation as a means of

*Stanley Brook and Tadmor are situated about forty-two miles south-west from Nelson City.

keeping the weeds from choking the crop. There can be no doubt that this is a wise procedure. Nevertheless, this step alone will be quite inadequate. In some instances where the 21-in.-drill method of sowing has been employed the crop has been smothered by yarrow, spurrey, or red-shank.

One farmer has secured a good crop of lucerne, and at the same time kept it free from weeds, by growing it with swedes (Fig. 3). The swedes have, of course, acted as a smother-crop, and so had the desirable effect of preventing the encroachment of weeds in the spaces

FIG. 2. YARROW SMOTHERING LUCERNE, STANLEY BROOK.

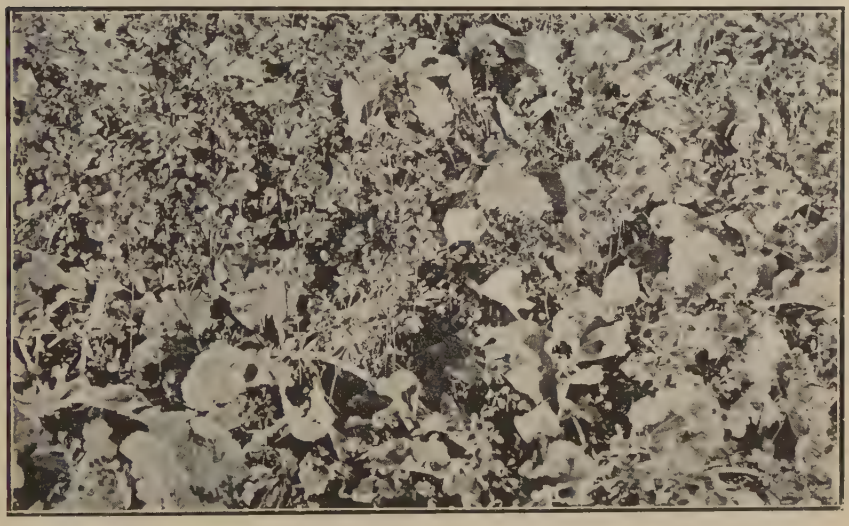


FIG. 3. LUCERNE SOWN BROADCAST WITH SWEDES, STANLEY BROOK.

between the lucerne-plants. There can be no doubt that so far as a fodder crop for one season is concerned the results of such an experiment will be good. However, the crop must be fed off, as the swedes preclude the mowing of the lucerne. The disadvantages resulting from feeding off lucerne and swedes from the same paddock will probably more than outweigh the temporary advantage secured. In the first place, the lucerne is not sufficiently well established to stand the trampling that the feeding-off of such a crop will entail. In the second place, it is probable that many weed-seeds will be spread in the droppings of the sheep. Furthermore, taking into consideration the fact that it would be bad practice to grow such crops as swedes, soft turnips, or rape year after year, it will be seen that any attempt to establish lucerne permanently on these lines will eventually prove to be futile.

Whilst drainage may in some cases be necessary, copious liming and the use of some implement such as a subsoiler to stir the subsoil without bringing it to the surface will be found the best additional means of opening up the soil and allowing the roots to get down.

FIG. 4. MR. H. KITE'S BROADCAST LUCERNE-STAND, TADMOR VALLEY.

[*Photos by J. M. Smith.*

In the Tadmor Valley, a few miles distant from Stanley Brook, one finds soil conditions of a distinctly opposite nature to those that have been discussed. The successful broadcast stand on Mr. H. Kite's property as shown in Fig. 4 is grown on a good river-silt—a type of soil suitable to the sowing of a broadcast crop. The crop is, generally speaking, very even and remarkably free from weeds.

Although it is true that there are soils on which both time and money may be wasted in futile attempts to establish lucerne, it may be considered that the Stanley Brook Valley is one in which perseverance will ultimately be rewarded. It may never be a lucerne district of the first grade, but with inoculation, liming, and the employment of methods of cultivation suited to the peculiar needs of the district much may be reasonably expected.

YELLOW-LEAF DISEASE OF PHORMIUM TENAX.

In the *Journal* for August, 1919, was published a report by Dr. L. Cockayne on an investigation carried out by him into the so-called yellow-leaf disease of *Phormium tenax*, since when considerable additional research work has been done. At the recent New Zealand Science Congress the subject formed the leading part of a discussion on the problems of the phormium-fibre industry. The following extracts from a report of the proceedings published in our official contemporary, the *Journal of Science*, afford information in brief regarding the present position of affairs relating to the disease and its incidence :—

Mr. A. H. Cockayne said that diseases were now the limiting factors in production of phormium ; of these the yellow-leaf disease was the most serious, rendering 6,000 acres unproductive. He exhibited specimens of diseased plants, showing how the outer leaves of the fans assume a yellow colour and ultimately shrivel up, while the next inner leaves are attacked, and so on. The problem his department had to solve was whether the disease was caused by bacteria, fungi, insects, or other pests. They had isolated six species of bacteria infecting the roots, none of which had developed under experimental conditions any pathogenic symptoms. A nemotode worm had also been investigated —one of these worms is the cause of a disease called "yellow stripe" in the similar monocotyledonous daffodils—but the numbers found were not sufficient to account for yellow-leaf disease. Insects also failed to account for the disease, though they caused trouble of another sort. Finally a fungus had been isolated, *Ramularia phormii*, and was held to be the cause of the disease. The delay in its isolation was the difficulty of sterilizing the surface of the roots, owing to their great porosity. Field experiments showed that only that portion of the root which absorbs water could be infected ; this was not the primary root, but the secondary or tertiary branches. Once these are infected the fungus spreads and reaches the primary roots. As it destroys the water-absorbing roots, the fungus prevents the absorption of water. When the swamps get very dry the disease spreads very rapidly. The fungus had been isolated, developed in pure cultures, reintroduced into healthy plants, and had produced yellow-leaf disease. Three methods of combating soil-diseases were known : (1.) Soil-treatment, of which well-known cases were the use of lime for club-root in cabbages, and sulphur for onion-smut. On the whole, few diseases could be controlled by this method. (2.) Crop-rotation, a method used successfully with a large number of diseases, such as "take-all" in wheat. All such cases were diseases attacking annuals, and the method was not possible with flax, which was a perennial. (3.) The use of disease-resistant strains. Wonderful success had been secured by this method in a great variety of diseases, including some caused by other species of *Ramularia*—*e.g.*, Irish-flax wilt, tomato-wilt, cotton-wilt, &c. Healthy plants growing in diseased areas had been selected for breeding and the diseases had been combated. The control of

yellow-leaf disease must be found along this line—the first essential being to discover whether races of phormium exist which are resistant or immune to the disease.

Mr. R. Waters, who had conducted the isolation of the fungus under the direction of Mr. Cockayne, mentioned the difficulty of sterilizing the exterior of so porous a root. In the end slightly infected roots were selected, a jelly was infected, and a growth obtained, of which he exhibited specimens. The results of infection of healthy plants were at first negative until seedlings were tried, when the disease quickly appeared. In answer to Professor Easterfield, who asked whether disease-resisting plants showed any root-infection, Mr. Waters stated that no work on disease-resistant strains had yet been done, but root-infection was absent from healthy plants. Replying to Dr. C. Chilton, who asked whether Koch's conditions as to proof of pathogenicity had been fulfilled, whether spores of the fungus had been obtained, and whether treatment of the soils might not also help, Mr. Waters said that all of Koch's conditions had not yet been fulfilled, owing to the short time since the discovery. Spores of two kinds had been obtained, both from the cultivated fungus and from diseased plants.

Dr. L. Cockayne (after dealing with other aspects of the phormium industry) briefly alluded to his previous work on yellow-leaf, and stated that he did not at first believe it to be a disease, but merely an effect of non-correct system of swamp-management.

After further discussion, it was resolved, on the motion of Dr. R. J. Tillyard, That a committee of flax-millers and members of the Congress be set up to go into the matter of forming a biological station to have the yellow-leaf disease investigated from all sides. The following were appointed members of the committee: Messrs. A. Ross, A. Seifert, and R. T. Bell, representing the flax-millers; and Professor Easterfield, Dr. R. J. Tillyard, Messrs. A. Cockayne and R. Waters, representing the Congress.

David Lubin.—The memory of the late David Lubin, of America, who was the prime mover in the founding of the International Institute of Agriculture, has been honoured in a striking manner by the General Assembly of the Institute, at Rome. It has resolved that the chair occupied by him in the meeting-hall from the initiation of the Institute shall remain unoccupied for ever, and that the name "David Lubin" be carved on the back.

Cheeseman's "Flora."—Inquiries having been received as to obtaining copies of the "Manual of the New Zealand Flora," by T. F. Cheeseman, it may be mentioned that this standard work is now out of print and only procurable second-hand. The work was published by the Government Printer in 1906 at a price of 16s., but has since become so scarce that within the last few years well-preserved copies have changed hands at more than double the original price.

Ruakura Sale of Stud Stock.—The second annual sale was held at the Ruakura Farm of Instruction, Hamilton East, on 12th April. Considering the present state of the outside stock-market the sale was distinctly successful, the strong demand evidencing that the quality and breeding of the Ruakura stock continues to be highly appreciated by farmers and breeders. Competition for the best Milking Shorthorn bulls was keen, the highest price, 90 guineas, being paid for a seven-month calf from Dominion Cora of Ruakura by Dominion Prince Daphne, while two other calves realized 72 and 71 guineas respectively. Jersey bull calves also brought satisfactory prices, the highest reaching 60 guineas. Berkshire pigs sold at figures slightly lower than those obtained at last year's sale. However, the demand for boars fit for immediate service was very brisk, and all of this class catalogued were disposed of at satisfactory rates, up to 16 guineas. Young sows, in lesser demand, made from 5 to 10 guineas.

The British Phosphate Commission.—The formal appointment, by the Governor-General, of Mr. Albert Fuller Ellis to be a member of the Board of Commissioners established under the agreement between the Imperial, Australian, and New Zealand Governments regarding Nauru and Ocean Islands is gazetted. Mr. Ellis's headquarters are at Auckland.

Ruakura Berkshires.—As bearing on the demand for this stock it may be mentioned that in the recently published Volume II of the Herd-book of the New Zealand Pig-breeders' Association 52 per cent. of the total transfers of pedigree Berkshire pigs in the Dominion are from the Ruakura Farm of Instruction.

Maize-growing Competition in Hawke's Bay.—The maize-growing competition promoted by the Hawke's Bay Agricultural and Pastoral Association this season was judged last month by Mr. J. W. Deem, Fields Instructor, and Mr. T. E. Rodda, Manager of the Arataki Horticultural Station. The awards were as follows: H. J. Fourneau (Pakowai), first, with 66½ points; Mrs. H. R. Clark (Koropiko) and D. Macnamara (Hastings), equal for second place, with 60½ points each; H. J. Fourneau's second entry next, with 59½ points. Mr. Deem reports that the crops on the whole were well grown, and should return an average of nearly 100 bushels per acre. The cultivation, with one or two exceptions, was very good, and this, no doubt, stood to the crops during the dry weather. The winning crop secured the maximum points under this heading. The varieties were very mixed, all showing signs of cross-fertilization. Mr. Fourneau's winning entry was the truest to type. While the maize crops in the Hastings district are returning good yields, there is no doubt that these would be considerably increased if seed of the best varieties, true to type, could be procured. Points brought out in the competition are the value of thorough cultivation, drills about 42 in. apart, and the use of 16 lb to 20 lb. of seed per acre.

WORK FOR THE COMING MONTH.

THE ORCHARD.

LAST month it was expected that a further shipment of fruit would be made per the "Waimana," due to sail shortly after the "Athenic," but this did not eventuate. The thirty-odd thousand cases carried by the "Athenic," therefore, represent the last shipment for the season. Information is not yet to hand regarding the "Hororata" shipment, but according to cabled reports an early shipment of fruit from Australia brought very satisfactory prices. A later shipment from the same source, however, was not so satisfactory, much of it—particularly pears—opening up in poor condition.

In the meantime practically the whole of our fruit crop has been harvested, and a considerable quantity of the late varieties of apples and pears is being held in cool storage. The completion of harvesting suggests the commencement of the dormant season. Growers have now before them a period during which much valuable work can be done toward placing their orchards in the most favourable state to meet the next fruit season's demands.

Local advice applying to the principal fruit districts (except Otago) is given in the notes which follow. Owing to staff changes Otago is unavoidably omitted this month. It will be noted that a new district has been created—Nelson Central, comprising most of the Moutere Hills—in charge of Mr. J. H. Thorp, with headquarters at Mapua.

—J. A. Campbell, Assistant Director of the Horticulture Division.

AUCKLAND.

After the heavy rush of work during the spring and summer months June will afford the orchardist some little leisure and an opportunity to attend to the general odd jobs which will require his attention in the orchard and about the premises. The thinning-out of temporary shelter-belts, trimming and topping of permanent breakwinds, renewals to breakages in glasshouses, and repairs to sheds, implements, &c., should be carried out during this month. Stocks of spraying-materials, manures, &c., should now be replenished, and sprayers overhauled.

The final work of preparation on new planting-sites should be pushed on. Where autumn ploughing is considered advisable this should be completed right away.

Orchardists are advised to keep a sharp lookout amongst their apple, pear, and quince trees for any signs of premature autumn tints on individual branches, which almost invariably point to the presence of fireblight canker These should be entirely removed, cutting well below the point of infection, and painting over the wound with a mixture of coal-tar and creosote, mixed to form a paste. The carrying-out of this work is especially desirable in the present circumstances.

—J. W. Collard, Orchard Instructor, Auckland.

HAWKE'S BAY.

General ground operations such as ploughing, preparation for planting, draining, cleaning out existing drains, &c., should be undertaken when the soil conditions are favourable. In spite of the lack of rain recently every effort should be made to prepare the orchard against a heavy downpour leaving stagnant water. The land should be ploughed towards the trees, and a furrow left open between the lines to carry off the surplus water. By so doing many trees can be saved from "wet feet" now and sour-sap later.

This month is a suitable time to trim, top, or thin shelter-trees, which may be done during the period the soil is unworkable, while very wet days may be profitably spent in cleaning up the packing-shed, and overhauling the spraying plant, implements, &c.

The pruning of fruit-trees will be the main work of the dormant season. As stone-fruit trees are first to attain the dormant stage, the pruning of these should be pushed on first. With the peach and nectarine, whatever form of pruning is adopted, it is important that the young fruiting-wood be properly spaced to ensure an even distribution of fruit, and consequently less susceptibility to brown-rot than would be the case if the growth were left crowded. Bearing-trees which have not furnished well with lateral growth should have the leaders cut well back to a strong yearling lateral, which should be left uncut; this will have the effect of forcing out growth on a more desirable part of the tree. The pruning of pip-fruit trees will follow, and this work should be proceeded with as the trees become ready. A lot of work has to be carried out during the dormant season, and anything which can be done now will ease the rush of work later on.

—W. H. Rice, Orchard Instructor, Hastings.

NELSON.

Packing fruit out of cool store will perhaps be work of first importance this month. Again growers are reminded of the necessity of marketing their stored apples in the right order. First the summer apples—Jonathan, &c.; next Delicious and Washington, followed by Dougherty and Rokewood; and finally Sturmer. If marketed in this order, or approximately so, the fruit should reach the consumer in good condition, and there will be a minimum of waste at the store.

Refitting and repairs to machines and implements, referred to last month, should be completed, together with the trimming of hedges and metalling of roads and approaches as required.

Pruning is usually commenced this month, and as it is a prime factor in the production of a good crop it cannot receive too much consideration. The theory and principles of orchard pruning have received a great deal of attention. The art of their application might well receive more. For example, what is the variety of the trees, what is their condition, and how did they crop last year? These are some of the questions to be answered before pruning can be commenced with much advantage. The pruner can do a great deal to modify bad qualities and make the most of good ones. Get the best talent possible for the work. "Improvers" should only work under close supervision.

Carefully set aside scions for any grafting to be done in spring. Push ahead preparations for planting as weather permits.

—W. C. Hyde, Orchard Instructor, Nelson.

NELSON CENTRAL.

When these notes appear all fruit will be picked, packing operations completed at the packing-sheds, and long-keeping varieties cool-stored for the late markets. It often happens that surplus fruit-cases are badly treated by being left out on the ground exposed to sun and rain, resulting in deteriorated cases for next year's use. Cases are too expensive for this to be allowed, and they should be collected and stowed away under cover if not required for present use. The same applies to orchard implements; in many instances rust and neglect cause more loss and depreciation than the hard work done all the season. Oil thoroughly before the tools are put away.

Now the crop is stored growers will have time to attend to drainage matters. There are evidences of this need in many places, both as regards surplus water unable to drain away and lack of care in preventing the entrance of water on to the orchard.

There are at present many orchards that have not received much cultivation during the past season, and a good amount of weed-growth is the result. If not already attended to this should now be ploughed under so as to give the material a chance to rot during the winter. The writer believes in good deep ploughing in the late autumn or early winter, followed by a lighter cross-ploughing in the spring or early summer. Plough up to the trees now, which will give the open furrows down the centre of the rows; any wash will then take place there and not away from the base of the trees.

Orchards badly infested with woolly aphis should be immediately sprayed with red-oil emulsion at 1-40. Do not let this pest rupture the laterals and buds and continue its destructive work right through the winter, as often happens.

Pruning-time will soon be round again. Arrangements are now being made by the various associations in the district for pruning demonstrations in the different localities, and growers are invited to attend and discuss the various problems in connection with this very important part of orchard practice.

—J. H. Thorp, Orchard Instructor, Mapua.

MOTUEKA.

Winter ploughing should now be well in hand, as advised in last month's notes.

Pruning operations should be commenced. Special advice regarding treatment of the various kinds of fruit-trees will be given, where desired, upon application to the Orchard Instructor. Beginners especially are advised to obtain instruction before starting on unknown methods. No rule-of-thumb method can be laid down for pruning. Individual trees require individual treatment. There are certain general principles, however, that must be borne in mind, and it is advisable to obtain as much knowledge of these as possible. Growers are recommended to again peruse the orchard notes published in the May and June numbers of the *Journal* last year, and apply the hints given therein.

—W. T. Goodwin, Orchard Instructor, Motueka.

CANTERBURY.

Pruning: When the trees have lost their leaves and show signs of being dormant pruning may be commenced. The habit, fruitfulness, the general development of the tree, the growth made during the past season, and the condition of the soil in which the tree is growing must all be taken into account when applying the principles of pruning. The art can only be mastered by practice.

Planting: Where fruit-trees are to be planted out this season this should be done before the end of May. Where this is not practicable planting should be delayed until the spring, when the ground has become reasonably dry, the trees being heeled in in the meantime.

Cultivation: Ploughing, if not already commenced, should be put in hand at once, so that it may be completed before the winter rains set in. Plough to the trees, leaving an open furrow along the middle between the rows, so that any water collecting will be as far away as possible from the roots.

Grafting: Unprofitable apple, pear, or other trees which it is intended to graft in the spring should be marked, so that time will not be spent in pruning them. The trees from which scions are to be taken should be carefully selected. When the scion wood is fully developed carefully collect and place it in sand in a comparatively dry shady spot until required.

Marketing: In marketing the late varieties of apples and pears the same careful attention is necessary as was given to the earlier varieties. Fruit in storage should be regularly examined, and placed on the market before it commences to deteriorate. Growers are strongly advised to repack all stored fruit before placing it on the market.

—W. K. Dallas, Orchard Instructor, Christchurch.

POULTRY-KEEPING.

F. C. BROWN, Chief Poultry Instructor.

MANAGEMENT OF THE BREEDING-BIRDS.

NEXT month should see preparations being made for the forthcoming breeding season, and a matter of first importance in this respect is to ensure that the hens intended for the breeding-pen are specially fed and managed in order that they shall be in the best possible form when their eggs are required for hatching.

In the first place, care must be taken that the hens are not supplied with a forcing ration to stimulate them to commence laying in the shortest time possible. If strong, hardy chicks, which are easy to rear, are to be produced, the plainer

the ration the better. Meat or its substitutes should be sparingly supplied, and as the season advances it should be cut out of the ration altogether. I would go further, and recommend that wet mashes be discontinued a month before eggs are required for reproductive purposes and right through the whole of the breeding season. We have ample proof that the strongest chicks are produced when the breeders are fed on a grain ration at all times. The grain should be fed in a manner that will induce the maximum amount of exercise—that is, thrown in deep litter. In addition to this the birds cannot be oversupplied with green-stuff, while fresh water and grit are details which must not be neglected. In speaking of a whole-grain ration for the breeders it is not to be inferred that this means supplying any one particular kind of grain, but rather that a mixture should be fed, such as wheat, oats, maize, peas, &c. It will usually be found that the greater the variation of food provided the better will be the fertility of the eggs and the stronger will be the chicks.

Using a plain ration, as recommended, it need not be expected that high egg-yields will be secured; but of what avail is it to have a record number of eggs if the chicks they produce cannot be hatched and reared with any degree of certainty? It is safe to say that half the troubles met with in the hatching and rearing of stock could be traced to mismanagement of the parent birds. Not only should the hens be specially fed and managed, but the male birds as well. Remember the sire is more than half the flock, and if he is to have the desired prepotency—the power to transmit his inherent quality to his offspring—he must be in the best condition possible—not too fat, but full of life and vigour.

It goes without saying that the best food-ration ever planned will not maintain the birds, and particularly the male bird, in the condition desired for breeding if the management they receive is weak in other respects. See that the birds are well housed, and, above all, make sure that the quarters are free from red mite and the birds themselves not troubled with body-lice. Strict attention to cleanliness and frequent disinfection of the interior of the houses is the secret of keeping the red mite at bay, while the provision of good dust baths is the best and most natural way for a bird to free itself from parasitic life. No care and attention is too good for the breeding-birds, whether it be before or during the whole time they are being called upon to produce eggs for the renewal of stock.

Male birds carrying large combs and long wattles, which is often the case with such breeds as Leghorns, Minorcas, &c., should have these removed before being placed in the breeding-pen. As a result of this slight operation a bird will usually feed better and produce a greater number of fertile eggs and strong chicks. The operation can be simply performed by means of a pair of sharp scissors. In order to prevent bleeding a good dressing of fuller's earth should be applied to the cut parts.

PULLETS AND THE LAYING-PERIOD.

A mistake, and an expensive one, which many poultrymen have made this season is to discourage the pullets from laying in the autumn by frequently changing their quarters and food or giving them a mere living-diet, with the hope of having the birds laying "at top" in the dear winter season. This is a bad practice, which has meant in too many cases that not only were autumn eggs lost, but a decent winter supply as well. Obviously the birds moulted, and it would have been surprising in the circumstances had they not. Where the pullet is showing signs of coming to lay before the dear-egg season sets in, forcing-foods such as meat, meat-meal, milk, &c., should be excluded from the ration, but in all other respects nature should be allowed to take its course. Once a growing pullet receives a set-back by being stinted of its food it seldom or never catches up the lost ground.

Speaking of pullets, it is commonly stated that this year they are slow in coming to lay. I attribute this in many cases to the dry season or to the inferior food supplied. Unfortunately, of late there has been difficulty in securing good foodstuffs. The bulk of the pollard now offering is nothing like the quality of old, while some of the mixtures sold as a substitute are dear at any price. If it can be avoided, it is poor economy to purchase inferior foods. With the present price of eggs it will be found a wise policy to provide the best of food-stuffs to the laying-pullets, quite regardless of their cost. If a good grade of wheatmeal is available, one part of this and two parts of bran will make a good mash mixture. Unfortunately, there is often difficulty in securing ground wheat, or, indeed, any ground grain of a desirable quality, as it would appear in most

cases that only inferior grains are ground for the use of poultry. Those who have no machinery to grind their own grains should endeavour to purchase a good sample of wheat and take it to a mill for grinding, for which operation not more than about 5d. a bushel should be charged.

MAKING CHARCOAL.

Charcoal is valuable for birds of all ages. Although expensive to purchase, it is nevertheless easy to manufacture. Willow-wood is suitable. It should be placed in a trench, say, 6 ft. long, 3 ft. wide, and 3 ft. deep. After a good fire has been made and fed so that the trench is a mass of burnt embers, the top of the trench or pit should be covered with sheets of old iron or similar material. On this throw some earth sufficient to exclude all air, except a draught-hole at each end of the trench Later these holes should be closed and the fire entirely smothered. In due course—say, after twelve hours—the pit may be opened, and by putting the charcoal through an ordinary grit-mill it will be ready for use. Of course, it should be sieved to suit the age of the birds it is intended for.

THE APIARY.

G. V. WESTBROOKE, Apiary Instructor.

SEASONAL work in the apiary now being over, and the bees closed down for the winter, beekeepers should spend their spare time in making preparations for the coming spring. Probably one of the first matters to attend to will be the rendering into blocks of wax of any old combs, pieces of wax, &c., that may be on hand. Among farmers, and those having a few hives only, quantities of wax are often wasted. It is not at all uncommon to find lying around near the hives large pieces of comb, which if collected would well repay the trouble. Allowing such pieces of wax to lie about is not only a direct loss to the owner (with wax at from 2s. to 2s. 6d. per pound), but is a potential source of danger to adjacent apiaries, by spreading disease and starting robbing, with consequent loss.

RENDERING WAX.

For the person with only one or two hives it would scarcely be worth while to invest in a wax-press, and perhaps the best method in such cases is to use the family copper. The usual procedure is as follows. Place the combs in scrim bags in the copper, putting some weights on them to prevent the wax from floating. Then nearly fill the copper with water, and bring it to the boil. Care must be taken to see that it does not boil over, and for this purpose it is advisable to have a dipper of cold water handy to add if it boils too furiously. If the wax should boil over there is a grave risk of setting the place on fire. When the wax is melted it floats to the surface, when it can be skimmed off while hot ; or the fire can be allowed to die out and the cake of wax lifted off the surface next day, when cold. The refuse or "slum gum" remaining in the bag should be taken out and buried ; or, if preferred, it can be set aside to dry, and used as fuel for the stove or copper fire, using only a little at a time, when the fire is well established.

Where there is any quantity of wax, however, it will pay the beekeeper to obtain a press. One of the best for the purpose of separating the wax from the comb is the Hatch press, which is usually advertised in the leading suppliers' catalogues. When using this or any other wax-press the usual method is to melt the combs in a large copper or wash-boiler, and when thoroughly hot dipper the wax into scrim bags which are previously placed in the can. The pressure is then applied gradually, thus squeezing out the hot wax. It is usually best to release the pressure when the wax ceases to run, and shake up the bag and repress it, when a little more will be extracted. An old cheese-press can be easily converted into an excellent wax-press.

While the wax is hot it may be run into benzine-tins, which make an excellent mould for the purpose—being square, the wax can be more easily packed for transmission to its destination. As there are now two or three firms manu-

facturing excellent foundation, both in the North Island and the South, it is more profitable to send the block wax to one of these firms to be made up. This can be done for about 1s. per pound, including freight.

ANNUAL CONFERENCE.

Beekeepers throughout the Dominion should, if possible, attend the annual conference of the National Beekeepers' Association, which is to be held in Auckland on 7th, 8th, and 9th June at the Chamber of Commerce. All persons interested in bees are welcome to attend.

VITICULTURE.

J. C. WOODFIN, Vine and Wine Instructor.

THE VINEYARD.

THERE is little work to be done in the vineyard during the coming month. In the larger vineyards where pruning is extended over a lengthened period through want of sufficient competent labour the pruning of those varieties which have lost their leaves and ripened their wood can be commenced.

CELLAR-WORK.

The racking of new wines should be continued where fermentation is over and the wines are bright and clear. Great care should be taken at this period of the life of the wine, as neglect may render a promising wine practically valueless. Wine left too long on the lees is liable to acquire a disagreeable taste and take on a turbid or muddy look.

The majority of the diseases of wine can be traced to insufficient care during the racking, or to dirty and tainted vats or casks. These latter should be carefully examined before they are used. They should be perfectly dry and sweet, and free from mouldiness and acidity. A vat tainted with mould will give a mouldy taste to the wine. To avoid this the vat should be swabbed with hot cotton-seed oil. After two or three days this should be removed with hot water and soda, and the vat when dry given several heavy sulphurings at intervals of a few days. Vats having a vinegary smell should on no account be used for wine.

When the new wine is racked and the vat carefully filled to the bung-hole the bung should be inserted, but not too tightly, as it is probable that a further slight fermentation will take place, and if the bung has been put in tight the result may be a loss of wine or even the bursting of the vat. Should fermentation be observed a "bubbler" or hydraulic bung, which allows the carbonic-acid gas to escape and keeps out the air, or a small sand-bag, can be placed on the holes.

When fermentation has ceased and the wine is still, potassium metabisulphite, at the rate of 2 oz. to 5 oz. per 100 gallons, can be dropped into the wine. Red wine requires less than white, and one-third to half of the quantity stated is sufficient for old wines. The metabisulphite will prevent further fermentation and keep the wine sound during the coming season. It should not, however, be used in sweet wines, as by diminishing the oxidation it retards the mellowing of the wine. The great advantage of the use of potassium metabisulphite over the ordinary process of sulphuring the wines with the fumes of a sulphur wick, or by burning sulphur in a suitable vessel and pumping it into the wine, is that in using the former the amount of sulphurous acid introduced into the wine can be exactly gauged, which is impossible in the latter case.

THE VINEHOUSE.

The pruning of vines from which the leaves have fallen can be commenced in June. A good pair of sharp secateurs is the best implement for this purpose. In using a knife one is liable to split the half-inch of wood which should be left above the dormant bud. Sometimes the wood is cut back too close to the bud, thus rendering the foundation of the new shoot so fragile that it is easily knocked off or will sometimes fall off without being touched.

The fruiting-laterals of the past season's growth should be pruned back to their base buds. On young vines there is usually one of these, but on older vines several will be noticed, one being more prominent than the others. These are the buds which produce the fruit-bearing laterals for the coming season Great care should be taken not to injure them.

In pruning vines it should always be kept in mind that a bud to be of any value for producing fruiting-laterals should be situated on wood of the current season, which is growing on wood of the last season, which in its turn is growing on wood of the previous season. The spurs thus formed become in time long and unsightly, some of them dying out through injury or other causes. When such is the case it is advisable to allow a new rod to grow from the base of the vine and to train it up alongside the old rod, allowing the old rod to fruit in the meantime. Under favourable conditions the young rod will run up to the top of the house before the end of the season. The terminal should not be interfered with, but any laterals inclined to take the lead should be controlled by pinching. During the growth of the rod an idea will be formed, from its growth and vigour, of the length to be retained at pruning-time, which may vary from a quarter to half of the final length it is desired to attain. When the point to which the rod is to be cut back is decided on all laterals below that point should be pinched back to two leaves. This will cause the dormant buds to plump up and produce vigorous laterals in the next season, when the new terminal lateral will be allowed to continue its way up to the top rafter, to be cut back in its turn if necessary. When it does eventually attain its full length the old rod can be cut out.

The vines having been pruned, all loose bark—and only loose bark—should be rubbed off, not scraped off with a knife or other instrument, as is frequently done. This latter practice should not be resorted to excepting in bad cases of mealy-bug infection, as it is detrimental to the healthy growth of the vine. Where mealy bug, red spider, or other vine-pests have been present during the season the vines should have a dressing of a solution of Gishurst Compound (6 oz. to the gallon of water), working it with a fairly stiff brush into the bark and round the buds, taking care not to injure them. A half-worn paint-brush would do. The woodwork of the house should be well washed—using a syringe for the crevices and corners—with a solution of the above-mentioned compound or a 5-per-cent. solution of Lysol.

The tops of the vines can now be tied back to the front wire, the tops being lower than the horizontal. This modifies the flow of sap when it rises, so that the top part does not get more than the bottom part, and the buds consequently break evenly along the whole length of the rod.

The remains of the mulching used on the borders during the past season can now be forked into the soil to form humus. A top-dressing of air-slaked roche-lime, at the rate of ½ lb. to the square yard, should be applied, using a rake to distribute it evenly into the surface.

THE GARDEN.

W. H. TAYLOR, Horticulturist.

VEGETABLE-CULTURE.

GARDEN management naturally differs very much in various localities. Thus in the warmer districts the cauliflower will grow all winter in the open ground, whereas in cold places it requires protection and cannot be planted out till spring is well advanced. In the warmer parts it is often impossible to grow broccoli, as these must be planted out in the hottest part of summer, when dry conditions and the cabbage-moth combine to cause failure. In these cases advantage should be taken of the mild winter conditions to grow a succession of cauliflowers, and the want of broccoli would not be felt. In such places a sowing of cauliflowers should be made about 1st April and another about a month later. An early kind only need be sown at the first-mentioned date. Two kinds, an early and a late, should be included in the second sowing. The two kinds will carry on the supply through and beyond the period usually covered by broccoli. The real purpose of broccoli is found in the colder districts where cauliflowers will not grow during winter.

The broccoli is quite hardy and will bear any amount of frost. It is quite indispensable in cold places, where the attacks made by the cabbage-moth are seldom so severe as to be beyond control. Seedlings of the early varieties of cauliflower should not be left to crowd each other in the seed-bed. These varieties have a tendency to form heads prematurely, when they are, of course, useless. To counteract this tendency the plants should be grown in the best manner possible. It is best to prick them off into rich soil as soon as they can be handled. If this is not practicable—in large cultivations it may not be—at least they should not be left longer in the crowded beds than can be avoided, but should be thinned out where very crowded, and planting out done as soon as possible. The first of these plants, as well as spring cabbages, should be ready to plant out in June.

For early work warm soil is desirable. Though warm districts have been specially mentioned, these early crops are also grown in many places where the climate is of an intermediate character, and, further, it is to be remembered that during the period of short days no soil is very warm. For this reason it is incumbent on the cultivator to do nothing which will tend to reduce the temperature of the soil. Thus, animal manure should not be dug into such land; horse-manure or like material holds water, which effects a lowering of soil-temperature. No such manure should therefore be employed for early crops, but land should be used that was well manured the previous season and has produced some other crop. A little artificial fertilizer will supply what is required. When the plants have commenced to grow after being transplanted a little nitrate of soda—a small teaspoonful scratched in above the roots of each plant—will quickly start them into active growth.

The remarks as to the cooling effect of manure are applicable to other crops. Early peas, for instance, are grown with best effect on land that is sufficiently rich to grow them without added manure. Seed-beds also are better without manure in early spring. It is well known to market-gardeners that horse-manure applied to the soil during winter or spring will retard the growth of rhubarb to the extent of delaying the first gathering by at least a fortnight. The retarding effect of farmyard manure containing a proportion of cow-manure would be even greater. The use of a mulch of manure with transplanted rhubarb or other plants (one occasionally sees it advised for roses) is the reverse of beneficial. The soil should be kept clean and a loose surface maintained, so as to admit warmth from the sun, and at that period manure is not wanted. Rhubarb is greatly benefited by stable manure applied at the right period, the best time being about midsummer after the pulling of stalks is discontinued. A mulch of manure given at that time will keep the soil cool, and fertilizing constituents are washed in with every rain at a time when the plants are active and will use it. The result shows in the improved quality of the crowns and promise for a good crop the ensuing season. Before growth begins some artificial fertilizer may be given.

Tomatoes under glass: Fertilizers play so important a part in the cultivation of this crop that they should not be used without some knowledge of the effects of the different kinds. The present intention is, however, merely to note a special point. Some form of nitrogenous fertilizer is usually, and quite rightly, employed to give vigour to the plant. It is well to know that nitrogen affects only the vegetative functions of a plant—that is to say, it increases leaf-growth. The form most frequently used is sulphate of ammonia. Nitrate of soda is also used, but to a less extent. The latter is quick-acting, while the former is more slowly available. For these reasons nitrate of soda is given only to the growing plant, and in small amount, because its effect is immediate and because it is soon washed out of the soil. Sulphate of ammonia is applied to the soil before planting, and the full amount intended is used at that time. In some conditions a small amount and always an excessive quantity, results in promoting a vigorous and soft growth. Growth of this kind is highly susceptible to disease attacks. Potassic fertilizers encourage the formation of carbohydrates, sugars, starch, &c. They particularly benefit the fruit of a plant, and exercise a hardening or stiffening effect on plant-growth. Sulphate of potash is the best form for use in this case, and should be regarded as a necessary accompaniment to a nitrogenous fertilizer. This is the practice in England, where in some establishments there are acres of tomatoes under glass.

PRUNING OF SMALL-FRUITS.

It is a good policy to get the pruning of small-fruits done as early as possible. Some authorities hold that early pruning has a beneficial effect on the buds. Exposure to winter weather must certainly have some effect in hardening the

wood, which is the more exposed because of the pruning. The benefit that is most easily seen, however, is that with the bushes pruned the ground can be cleaned and all made tidy, a positive benefit both to soil and bushes.

Gooseberries: Pruning should be more in the way of thinning than cutting back. The young shoots made this season will bear fruit next season; fruit is also borne on spurs on older wood. The crop borne on young shoots is of greater consequence, and shoots of fair vigour are best. Although every young shoot will bear fruit it does not follow that the greater the number of young shoots the heavier the crop. Every plant has a limit of capacity to bear fruit, and if the limit is too nearly approached the size and quality of individual fruits will be poor. The main branches should not be too numerous, a crowded state of bush being avoided so that light may reach every part. The bush should be only of such density that fruit can be gathered easily without a lot of scratching of hands. That state of bush represents a safe limit of growth that is profitable. Long young shoots should be reduced by a few inches, according to their position and habit. Thus drooping shoots may be reduced so as to take off most of the bent portion; others may be merely tipped. Short shoots need not be touched except when they are in the centre of the bush and low down; they should then be reduced to spurs.

Red currants: These bear only on spurs on wood more than one year old, and never on young wood. All side shoots should be reduced to spurs from ½ in. to ¾ in. long. The bushes should be trained in cup form with an open centre, so that the sunlight can reach every part.

Black currants: These bear on spurs on old wood, and also on young wood. In former times it was customary to cut all young shoots back to spurs and take all the fruit from spurs on the older wood. The borer trouble, however, has caused a modification of methods. By taking advantage of the habit of bearing on young wood, branches may be cut out and replaced by young ones without having to wait too long for fruit. Even with this plan a large part of the crop is taken from spurs, but these form naturally in most cases, rather than as a result of shortening shoots. The bushes are not trained to cup form, but new shoots from below the soil-surface are allowed to push up where they chance to come. Older branches are cut out to make room for them. This enables the cutting-out of branches affected by borers before there has been any loss of fruit. It takes several years for borers to seriously damage a branch, and by the time that state is reached there are young branches to take the place of those damaged.

PARAGON PEACH PACKED FOR MARKET (SEE ARTICLE "FRUITGROWING IN THE WAIKATO," PAGE 292.)

THE COMPOSITION AND FEEDING-VALUE OF SILAGE.

[From the *Journal of the Ministry of Agriculture*, London, June, 1920.]

THE steady extension of the practice of ensilage in this country (Great Britain) in recent years has made it desirable that the meagre information hitherto available as to the composition and feeding-value of silage should be supplemented as far as possible. The older analyses can hardly serve as a reliable guide to present-day practice, in view of the greater variety of crops and the improved methods of preparation now used.

With a view to initiating the collection of reliable data, arrangements were made by the Food-production Department in 1918 for obtaining from various sources samples of silage made in 1918–19. The analysis of seventeen samples was undertaken by Mr. Gwilym Williams, of the School of Agriculture, Cambridge, and his results are summarized in the accompanying table. Estimates of the relative feeding-values are also given, these estimates being based upon the composition and digestibility of the materials.

MOISTURE.

Attention may be directed first to the fact that there was great variation in the proportion of moisture in the seventeen samples (ranging from 58·4 per cent. to 81·62 per cent.), and conversely to the percentage of dry matter (ranging from 41·6 to 18·38 per cent.). The highest percentage of moisture (81·62) is accounted for by the fact that this sample was a maize silage, the thick, fleshy stems and leaves of this crop inevitably carrying a large proportion of water into the silo. The three driest samples were all from one farm, and it would seem that either the crop was allowed to ripen to an appreciable extent before cutting or was dried somewhat before transferring to the silo.

Apart from these four samples the percentages of moisture are distributed fairly uniformly between the limits of 67 per cent. and 78 per cent., which may perhaps be regarded as the normal range of variation, with an average in round figures of 73 per cent. moisture, or 27 per cent. dry matter.

ALBUMINOIDS, OR PROTEIN.

The albuminoids (or protein) of feeding-stuffs always possess a special importance, since they have certain bodily functions to sustain which no other ingredient can support.

In some analyses a distinction was made between "crude albuminoids" (or crude protein) and pure albuminoids (or pure protein). The former represents the total nitrogenous matter of the silage, while the latter indicates how much of this is real albuminoid material. The difference (commonly referred to as "amides") represents nitrogenous ingredients which, though not without value to the animal, do not possess the full virtue of the true albuminoids. These "amides" are always present to some extent in the green-stuff as it goes into the silo, but the fermentation processes which take place there tend to increase the proportion of "amides" at the expense of the true albuminoids. Consequently, so far as the feeding-efficiency of its nitrogenous matter is concerned, the silage is somewhat inferior to the green fodder from which it is made. In the nine cases where the separate determinations were made the pure albuminoids formed from 50 to 81 per cent. of the crude albuminoids.

The point is probably not of serious practical consequence, however, since the silage will commonly be fed as part of a mixed diet, the other ingredients of which can be made to ensure an adequate supply of albuminoids.

CARBOHYDRATES AND FIBRE.

The feeding-value of silage in a mixed diet will be chiefly determined by its content of digestible carbohydrates and fibre. The loss due to fermentation in the making of silage falls more heavily upon the carbohydrates than the fibre,

so that the proportion of the former is somewhat lower than in the original green fodder. The proportion of fibre is consequently increased, but it is probably rendered more digestible by the fermentative action. With the exception of a trifolium silage, the proportion of carbohydrates was appreciably higher than that of fibre.

RELATIVE FEEDING-VALUE OF SILAGE.

In order to obtain an estimate of the feeding-values of the various silage preparations as compared with each other and with roots and hay respectively, the "starch equivalent" method of assessment was used. For the purposes of this method it is necessary to know not only the composition but also the digestibility of each material. In the case of these silage samples, however, there was no information as to their actual digestibilities, and consequently it has been necessary to assume the same digestibility for each, this being taken as the average digestibility of oat and vetch silage given in published tables of digestion coefficients. As there was no means of knowing how far this assumption may have been valid, the estimates of feeding-value arrived at can only be regarded as rough approximations.

The feeding-values were expressed as "maintenance starch equivalents," the figures representing the number of pounds of starch which, in a mixed diet containing an adequate supply of albuminoids, would have the same value for simple "maintenance" purposes as 100 lb. of the silage. Taking these figures as the basis, and the corresponding "maintenance starch equivalents" for roots and hay of average quality, the data given in the last two columns of the table are arrived at.

In this connection it may be pointed out that although silage in farm economy and feeding-practice serves commonly as a substitute for root crops, its only outstanding resemblance to roots in feeding-properties is its succulence. It is more fibrous and less digestible than roots, and in chemical composition, apart from its high moisture content, resembles the hay that might alternatively have been made from the original green fodder.

The estimated "starch equivalents" range from 10·3 per cent. for the maize silage to 23·3 per cent. in the case of a lucerne and seeds second-crop silage. The value in terms of roots ranges from 1·12 to 2·54 tons of roots per ton of silage, while in terms of hay the range is from 2·1 to 4·76 tons of silage, equal to 1 ton of good hay.

The wide range of variation thus indicated is due more to the great differences in moisture content of the silages than to intrinsic differences in the feeding-value of the actual nutritive matter. If the silages are reduced to a comparable basis of 70 per cent. of moisture (or 30 per cent. of dry matter) the range of variation in starch-equivalent is only from 15·5 per cent. to 17·8 per cent.—that is, the best is only about 15 per cent. better than the worst. In view of the assumptions underlying these estimates it will be safest to conclude that, so far as chemical analysis can furnish guidance, the various silages had substantially the same feeding-value apart from the variations in moisture content. This conclusion only holds good if the silage is fed in a mixed diet which supplies sufficient albuminoids for the needs of the animal. If the albuminoid-supply were scanty the silages containing the higher proportions of albuminoids would have a higher intrinsic value than they are credited with in the above estimates.

Assuming 30 per cent. of dry matter, the average "starch-equivalent" for the seventeen samples is 17·05 per cent. One ton of such average silage would be equivalent for "maintenance" purposes to 1·85 tons of roots; or 2·87 tons of silage would be equivalent to 1 ton of good meadow hay. These figures bear out closely the opinion expressed by Mr. Arthur Amos in his recent address to the Farmers' Club.* "Taking into account the chemical analyses and the feeding experiments, I am of opinion that 3 lb. of oat-and-tare 30-per-cent. silage may be regarded as having a value slightly greater than 1 lb. of good oat-and-tare or clover hay, and that 1 lb. of oat-and-tare 30-per-cent. silage is equal to slightly less than 2 lb. of roots. . . ."

In conclusion, it must be borne in mind that chemical composition, although the most important, is not the only factor determining the nutritive value of feeding-stuffs. The physical condition, palatability, &c., must also be taken into account; these factors will doubtless in actual practice have given rise to greater differences in the values of the respective silages than are indicated by the above estimates.

* Contributed to the *Journal of the Farmers' Club* in 1920.

ANALYSES OF SILAGE CARRIED OUT AT CAMBRIDGE FOR THE FOOD-PRODUCTION DEPARTMENT IN 1919

No.	Nature of Sample.	Water.	Fat (Ether Extract).	Crude Albuminoids (or Crude Protein).	Carbohydrates.	Fibre.	Ash.	Pure Albuminoids (or Pure Protein).	Maintenance Starch Equivalent.	Tons Roots Equivalent to 1 Ton Silage for Maintenance.	Tons Silage Equivalent to 1 Ton Good Meadow Hay for Maintenance.
		Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Tons.	Tons.
1	Grass, tares, and small quantity of oats	60·17	1·20	5·01	18·82	11·06	3·74	3·24	22·8	2·48	2·15
2	Tares and oats	62·27	0·98	4·48	17·90	11·29	3·08	2·93	21·7	2·36	2·26
3	Lucerne and seeds, second crop	58·40	2·11	6·02	15·20	13·50	4·77	4·41	23·3	2·54	2·10
4	Tares, wheat, and oats	71·00	2·17	4·12	11·77	8·72	2·22	2·48	17·2	1·87	2·85
5	Clover	67·37	1·01	4·85	12·62	9·45	4·70	3·92	17·9	1·94	2·75
6	Maize	81·62	1·37	3·25	6·93	4·48	2·35	1·79	10·3	1·12	4·76
7	Trifolium	70·13	2·53	3·92	10·28	10·96	2·18	2·41	17·5	1·90	2·80
8	Tare, oats, rye, and marsh-grass	74·20	2·07	2·70	10·34	8·27	2·42	1·52	14·9	1·62	3·29
9	Oats and tares	72·30	2·47	3·63	11·39	8·02	2·19	1·80	16·4	1·78	2·99
10	Clover	74·53	0·97	3·53	8·96	7·93	4·08	..	13·15	1·43	3·72
11	Grass	78·50	1·53	2·91	8·98	5·65	2·43	..	12·4	1·35	3·95
12	Tares, oats, rye, beans, and wheat—all grown together	72·13	1·26	3·27	12·89	8·21	2·24	..	16·3	1·77	3·01
13	Trifolium	74·70	1·32	3·73	8·99	9·05	2·21	..	14·2	1·54	3·46
14	Trifolium	72·70	1·25	3·80	10·16	10·34	1·75	..	15·55	1·69	3·15
15	Trifolium (second sample)	70·23	1·19	3·36	11·84	10·48	2·90	..	16·45	1·79	2·98
16	Rye, oats, and tares	77·80	0·67	2·72	8·86	8·69	1·26	..	12·6	1·37	3·89
17	Clover	73·50	2·45	3·24	10·71	7·67	2·43	..	15·75	1·71	3·11
									Average	1·78	3·13

MATANGI DRIED-MILK FACTORY, WAIKATO.

This establishment, situated between Hamilton and Cambridge, may be regarded as the model of its kind in New Zealand. It is owned by the New Zealand Co-operative Dairy Company, and deals with the milk of 12,000 cows.

B. M. Gibson, photo.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

VEGETATING OF LOOSE FACES IN HIGH COUNTRY.

"WHALESBACK," Fairlie :—

Will you kindly advise me on the following points : (1.) Under what conditions will marram-grass grow ? Would it be suitable in the Mackenzie country to prevent shale-rock faces from slipping, thereby enabling grasses, weeds, &c., to become established thereon ? The altitude is from 2,500 ft. to 3,000 ft. above sea-level, and the land is swept by very cold winds in winter and hot, dry nor'westers in spring and summer. It is also subject to very hard frosts. (2.) What grasses are best adapted for surface-sowing on this class of country, bearing in mind the dryness of the summer months ?

The Fields Instruction Branch :—

Marram-grass will grow in almost any locality on sand-drifts. It is to be found growing on moving sand from the seashore to the inland regions. It would not be suitable, however, for planting on ordinary shingle-slips. The grassing of the class of country mentioned presents many problems which have not as yet been solved. Anything that will grow on high dry country is to be appreciated. A plant that is a weed in good arable land may be quite a useful plant under the circumstances mentioned. It should be the aim of any one owning such country to get the surface covered, so as to prevent soil-depletion by the fierce gales experienced. The introduction of winged thistle (*Carduus pycnocephalus*) is to be recommended, as it affords both feed for stock and shelter for other plants that may chance to establish. The sowing of cocksfoot, yarrow, wild white clover, and Poa pratensis is to be recommended after the winged thistle has established itself.

CLUB-ROOT IN THE GARDEN.

W. P., Kaiata :—

Can you inform me of an effective cure for club-root ? The gardens here are full of it.

The Horticulture Division :—

Club-root of cabbages and other plants belonging to the order Cruciferæ is caused by a slime fungus, *Plasmodiophora brassicae*. This fungus thrives in an acid soil, but is not found in soil that has a sufficiency of lime. The organism is able to lie quiescent in the soil for a number of years. It does not spread from plant to plant through the air, but pieces of infected roots, or soil in which infected plants grew, will, if carried to clean ground, spread the disease. Diseased roots should be destroyed by fire or by burying them very deeply in the ground. Affected ground should be limed as soon as the crop is removed, giving at least 2 tons of ground lime per acre Liming will not at once destroy the fungus, therefore cruciferous plants should not be grown in ground known to be infected until several years after liming. So far as gardens are concerned, recent pronouncements point to an easy remedy. It is stated that the fungus can live only within a few inches of the surface—some authorities say 5 in., others 8 in. If this is the case deep trenching to bury the top soil, and liming the turned-up subsoil, should get rid of the disease. Experiments are being conducted to try this out.

INDICATIONS OF PREGNANCY IN COWS.

"INQUIRER," Waitanguru :—

Could you inform me of any way of telling if a cow is in calf before she goes dry?

The Live-stock Division :—

When a cow has been served only a few weeks there is no means of telling whether she is in calf or not, and one can only come to the conclusion that she is in calf by her not returning to the bull. It frequently happens that a cow gets in calf when served and aborts at the end of two or three months, and this could easily escape notice. In due time, however, such an animal would show signs of returning to the bull. A good indication that a cow is in calf is extension and dropping of the abdomen, more particularly at the right flank. At this time the movements of the calf can also be observed, especially after the cow has had a drink of water, but with the exception of the fœtal movements these indications cannot always be relied upon. To make certain that a cow is in calf an examination per rectum is necessary, when the calf can be felt beneath the hand. Such an examination should only be made by an experienced individual, otherwise injury to the cow may result.

RINGING A BULL.—FEEDING POTATOES TO DAIRY CATTLE.

"FRIESIAN," Waihao Downs :—

Will you kindly tell me (1) the best method of ringing a bull, and the best age to do it; and (2) if raw potatoes are injurious to dairy cows.

The Live-stock Division :—

(1.) The best method of ringing a bull is to make a hole with a special punch in the septum of the nose. The bull's head should be tied up to a strong post, the muzzle grasped with the left hand, and the punch placed in position just behind the muzzle, the handles of the punch being then grasped tightly with the right hand. By this means a neat hole is cut in the septum of the nose, through which the ring is pushed and the screw fixed. Copper rings with a sharp point on one half can be bought. These simply require pushing through the septum of the nose and fixing with a screw. After the operation the animal's head should be released. The best time to ring bulls is when they are about six months old.

(2.) The practice of feeding potatoes to dairy cattle cannot be recommended. If potatoes are used they must be perfectly sound and in good condition, and should only be given to cattle in small quantities, as they are liable to cause excessive diarrhœa and flatulency unless fed very carefully. If the potatoes are sprouted, or have been exposed to light so as to become in any way green, they are dangerous for feeding to stock and may cause poisoning. The peel of green potatoes or potatoes that have sprouted contains an acute principle called solanin, which causes the conditions mentioned

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KILLING OBSTRUCTIVE TREES.

R. M. BANNISTER, Longbush :—

Will you please inform me of the best method of destroying full-grown willow-trees? The trees are growing on the banks of a running stream and the roots obstruct the flow of water.

The Horticulture Division :—

The most effective method of killing trees has been proved to be a combination of ring-barking and arsenical poisoning. This method consists in making a series of downward cuts with an axe, completely girdling the tree as near the ground as possible. None of the chipped wood is to be removed. The object is to make a kind of basin to hold the liquid. Poisoning should be done while the sap is down, the best time to treat willows being when the leaves are falling. To make the arsenical liquid, boil 3 lb. washing-soda and 1 lb. white arsenic in 1 gallon

of water; keep stirring till dissolved. Take from the fire and add 3 gallons of cold water. A quart of this mixture is sufficient for a fairly large tree. If preferred, 2 lb. of caustic soda may be used in place of 3 lb. of washing-soda. In this case boiling is not required, as the heat generated by the caustic soda is sufficient to dissolve the arsenic. This liquid is very poisonous, and, as it is practically impossible to cleanse the vessel in which it is boiled, great care should be exercised in its future use; water from it would poison any animal. Instead of this mixture any of the proved weed-killing specifics may be used. A strength at least double that advised for killing weeds would be necessary. This would save the trouble of making a special solution.

DODDER IN LUCERNE.

G. P., Cambridge:—

I am enclosing a specimen of what I take to be dodder from lucerne sown last December. I have found several small patches of this weed in the crop. Will the parasite kill the lucerne, or will the constant cutting eradicate the dodder? Could the crop be treated in any way for the eradication of the latter?

The Fields Instruction Branch:—

The specimen of lucerne enclosed with your letter is attacked by dodder (*Cuscuta* spp.), which is one of the greatest enemies of lucerne. If any patches show up in subsequent growths in your lucerne crop do not allow the dodder to seed, but remove the affected growth as soon as possible. This can be done by chipping the plants to the crown on the affected patches and a yard beyond. Heap up the whole in the centre and add some dry straw or other litter, and burn. Do this before mowing the crop. The burning will not materially injure the lucerne-plants. Lucerne-seed should always be tested for purity in order to ensure that no dodder-seed is present.

TREATMENT OF SEED-POTATOES.

"SUBSCRIBER," Okoia, Wanganui:—

Would you kindly advise me as to the best treatment for seed-potatoes between digging and planting? Is it advisable to "green" them in shallow boxes in the sun? If so, how is this done?

The Horticulture Division:—

The greening of the sets by exposure to the sun is of use when immature sets are dug. Exposure to the sun hardens the tender skin and prevents injury in handling. Greening, however, has no application to this time of year. The plan advised is to place the sets, rose end upward, in shallow boxes, and expose them to moderate light and a free current of air. Boxing should be done before the eyes begin to sprout. When started in this way the sprouts are short-jointed, tough, with a good hold on the tuber, and are green. When sprouted in a heap or in a dark place the sprouts are long, white, very brittle, and easily broken off. Sets sprouted in the manner advised produce the best crops.

MAKING GREEN-HIDE LEATHER.

"ANXIOUS," Matata:—

I am desirous of making green-hide leather, and should be glad to be advised of the method of treating the hide for this purpose.

The Live-stock Division:—

After cleaning the hide and freeing from hair by the ordinary process, the stock is steeped or paddled in a solution of bichromate of potash and sulphuric acid, 5 per cent. of chromate to 2½ per cent. of acid on the wet weight of the stock. When this solution is thoroughly absorbed the stock should be a canary-yellow throughout. Then remove the stock from the bath and spread it out flat

to drain overnight. Next immerse in a solution containing 7½ per cent. of hyposulphide of soda (ordinary hypo) and 2½ per cent. sulphuric acid, again estimated on the original wet weight. When this reducing-bath has completed its work the leather should be a pale green, and should stand boiling without going hard or curling up. This latter test is a proof of well-tanned leather. This leather dried out is known as "chrome sole," and can be made waterproof by impregnation with paraffin wax. Care should be taken in the latter process to keep the wax at as low a temperature as possible while immersing the leather in it.

PIG WITH DROPSICAL EAR.

E. B. BOLAND, Tolaga Bay :—

Kindly advise me as to the cause of one ear of a pig becoming greatly enlarged from top to bottom, apparently containing fluid. Could you advise treatment, and state if the trouble is infectious? The pigs are running in a grass-paddock, have good sheds to sleep in, plenty of grass and separated milk, and are in good condition.

The Live-stock Division :—

This condition is not an unusual one in some parts of Great Britain, and is due, as a rule, to an injury such as a bite or a kick, or from the pig continually shaking the head because a foreign body has found its way into the ear. The trouble is not infectious, and can be remedied by simply opening up the ear with a clean knife, after thoroughly washing the ear. The wound as a rule heals quickly, and as a result the ear often contracts.

SPLITTING OF PEACH-STONES.

"AMATEUR," Geraldine :—

Can you inform me of the cause of peach-stones splitting? The trees are perfectly healthy and the fruit good, except that every stone is split. I have been advised to cut off some of the roots. Would this be beneficial? The trees have been heavily manured with sheep-droppings. Would this cause such a condition?

The Horticulture Division :—

The cause of peach-stones splitting has never been satisfactorily explained. The general opinion is that it is due to want of lime. Some think it due to excess of nitrogen. If your soil is deficient in lime the sheep-manure applied would certainly accentuate the requirement. With a sufficiency of lime an application of sheep-manure would be quite good practice.

HANDLING OF ARTICHOKES.

H. WILLIAMS, Havelock :—

Could you kindly give me some information about the growing of artichokes for pigs, and the best way to save tubers for seed? I bagged some one year, but they all rotted. Would they keep all right where they grow?

The Horticulture Division :—

Artichokes store badly. If exposed to air, as they would be in bags, they quickly shrivel, and if not fully matured soon rot. There appears to be a growing tendency to lift the tubers too early. They keep quite well in the ground, and should be left there as long as possible. Planting is done in August, the tubers beginning to grow about that time. The supply for use should be lifted as needed, and shortly before growth begins again the remainder of the crop should be lifted. The requisite number of medium-sized tubers for the next season's crop should then be taken and replanted at once, the remainder being clamped for a short time till used up.

BLINDNESS IN DOG AFTER DISTEMPER.

"INQUIRER," Cape Runaway :—

I have a sheep-dog which had distemper when fourteen months old. She went blind in one eye, and the other is now becoming similarly affected. The blindness appears to be due to a film over the outside of the eyeball, pus coming from the eye now and again. Would you kindly inform me of a cure if there is any ?

The Live-stock Division :—

This is a condition which frequently occurs as the result of the catarrhal form of distemper. The eyes should be bathed twice daily with a warm boracic-acid solution and cleaned out with a portion of cotton-wool. Drop a small quantity of the following lotion into the eye after bathing : Zinci sulpho-carbola, 5 grains ; distilled water, to 1 oz.

DEADLY NIGHTSHADE.

"INQUIRER," Carterton :—

Would you kindly inform me if the weed called "deadly nightshade" is poisonous ? I have lost several lambs on both rape and turnips lately and cannot account for their death.

The Live-stock Division :—

There are two nightshades, the common or black (*Solanum nigrum*) and the deadly nightshade (*Atropa Belladonna*). The former variety, which is fortunately much the commoner, possesses no virulent poisonous properties, and as a rule is untouched by stock. The latter is distinctly poisonous, particularly at the flowering-period, when it is cut for medicinal purposes. The root also contains the active principle. The plant, when taken in toxic doses, produces paralysis—a staggering gait and death from asphyxia.

NOTICE.—An answer cannot be given to "Ducks" unless the proper name is supplied as well as the *nom de plume*.

FORTHCOMING WINTER SHOWS.

Otago A. and P. Society : Dunedin, 31st May, 1st to 3rd June.
Waikato Winter Show Association : Hamilton, 31st May, 1st to 4th June.
Manawatu and West Coast A. and P. Association : Palmerston North, 21st, 22nd, 23rd, and 24th June (National Dairy Show).
South Taranaki Winter Show Company : Hawera, 5th, 6th, 7th, 8th, and 9th July

(A. and P. Association secretaries are invited to supply dates and location of their shows.)

Unidentified Subscription.—An envelope bearing the Nelson post-mark has been received, containing 4s. in 2d. stamps, together with an uncompleted *Journal* order form. The sender should communicate with the publisher.

Breaches of Fertilizers Act.—On 1st March last the New Zealand Farmers' Co-operative Association of Canterbury was convicted at Christchurch on eight charges brought under the Fertilizers Act by the Department of Agriculture. On the charge of selling bonedust not up to warranty (in nitrogen) a fine of £5 and costs was imposed, and on the other counts costs only were ordered to be paid.

Wheat and Oats Threshings.—Returns of actual threshings received to 21st April by the Government Statistician from millowners showed that until then 3,596,050 bushels of wheat and 1,795,583 bushels of oats had been threshed out. The average yields per acre in cases where particulars of areas were furnished (covering 98 per cent. of total threshings) worked out at 33·05 bushels for wheat and 35·75 bushels for oats.

WHEAT RETURNS BY GROWERS.

UNDER the current wheat regulations it is specified that on or before 7th June, 1921, every grower of wheat shall make to the Wheat Controller returns showing, as at the 31st day of May, 1921—(1) The number of bushels of each variety of wheat grown by him and threshed but not yet sold and delivered; (2) how much of such wheat still lies on the grower's farm; (3) the location of any such wheat which is stored or held elsewhere; (4) the estimated quantity of wheat, in bushels, which the grower has still unthreshed—the quantities of each variety of wheat to be stated separately; and (5) the probable date of threshing and delivery to the market. In the case of all wheat remaining unthreshed on 31st May, 1921, the grower shall, within one week after the threshing thereof, make to the Wheat Controller a return showing the actual yield of each variety.

IMPORTATION OF EGG-PULP, ETC.

AN Order in Council was gazetted on 28th April prohibiting the importation into New Zealand of egg-pulp and white or yolk of eggs, also any similar preparation of eggs, save with the consent of the Minister of Customs given on the recommendation of the Board of Trade.

MAXIMUM PRICES OF FOWL-WHEAT AND SEED-WHEAT.

THE following extracts from this year's Wheat Regulations are published for general information :—

FOWL-WHEAT.

The maximum price of free wheat inferior in quality to good milling-wheat, when sold by the grower, shall be a price equivalent as regards the grower to the Government price of Tuscan wheat for the same month of delivery, less 2d. per bushel.

The maximum price of free wheat inferior in quality to good milling-wheat, when sold wholesale by millers, brokers, or other purchasers from the growers free on board or rail at the nearest port or railway-station on the usual trade terms as established at the date of this Order in Council, shall be the Government price for good milling-wheat of Tuscan variety delivered free on board or rail at the nearest port or railway-station in the same month, less 1d. per bushel. When sold otherwise than free on board or rail at the nearest port or railway-station on the said trade terms, the maximum price shall be a price equivalent as regards the seller to the maximum price aforesaid.

The maximum price of free wheat inferior in quality to good milling-wheat, when sold retail for delivery in any month by any person other than the grower, shall be the same as the price lawfully payable for similar wheat of Tuscan variety when sold wholesale by millers, brokers, or other purchasers from the growers for delivery in the same month free on board at Lyttelton on the usual trade terms, with the following additions only to such lawful price—namely, an addition of 15 per cent., together with a further addition of the transit charges actually paid by the retail seller of such wheat.

SEED-WHEAT.

The maximum price of seed-wheat being good milling-wheat (other than machine-dressed wheat), when sold for delivery free on board or rail at the nearest port or railway-station on the usual trade terms as established at the date of this Order in Council, shall be the millers' price for good milling-wheat of the same description delivered free on board or rail at the nearest port or railway-station in the same month, with an addition of 5d. per bushel. When sold otherwise than free on board or rail at the nearest port or railway-station on the usual trade terms as aforesaid, the maximum price shall be a price equivalent as regards the seller to the maximum price aforesaid.

The maximum price of machine-dressed seed-wheat shall be the maximum price fixed by the last preceding clause, with the further addition of 5d. per bushel.

DIRECT TRADE WITH SOUTH AMERICA.

ARRANGEMENTS were made with the Shaw, Savill, and Albion Company for one of their London-bound steamers leaving about the end of March to call at Monte Video with a view of affording an opportunity to make shipments of stud stock and fruit to Argentina. Owing, however, to the insufficiency of cargo offering, the voyage by that route was abandoned. The Shaw, Savill, and Albion Company via Montevideo towards the end of July, and will advise later as to the steamer now inform this Department that they anticipate despatching a steamer to London and approximate date of departure. Inquiries regarding freight should be addressed to the company's agents at the nearest port.

IMPORTATION OF FERTILIZERS: MARCH QUARTER.

FOLLOWING are the importations of fertilizers into New Zealand for the quarter ended 31st March, 1921, the name, quantity, and value of each kind, together with country of departure, being specified :—

Sulphate of Ammonia.—Australia, 99 tons, £2,592.

Gypsum.—Australia, 26 tons, £78.

Basic Slag.—Australia, £2 ; Belgium, 115 tons, £1,116.

Blood-and-bone.—Australia, 37 tons, £1,100.

Bonedust.—Australia, 432 tons, £6,969.

Char Dust and Bone Char.—Australia, 68 tons, £522.

Guano.—New Caledonia, 1,526 tons, £3,303.

Rock Phosphate.—Australia, 529 tons, £2,320 ; Gilbert and Ellice Islands, 514 tons, £1,271 ; Nauru Island, 4,900 tons, £9,971 ; Makatea Island, 11,190 tons, £27,706 : total, 17,133 tons, £41,268.

Superphosphate.—Australia, 5,079 tons, £33,593 ; Japan, 1,942 tons, £14,512 : total, 7,021 tons, £48,105.

Kainit.—France, 225 tons, £2,147 ; Germany, 120 tons, £809 : total, 345 tons, £2,956.

Sulphate of Potash.—Germany, 10 tons, £369.

Sulphate of Iron.—United Kingdom, £6.

Other Fertilizers.—United Kingdom, 1 ton, £27.

NOTE.—With regard to the "declared values" which are given above, the Comptroller of Customs gives the following explanation: "The value for duty is the fair market value in the country whence the goods are imported plus 10 per cent. As the addition of 10 per cent. does not nearly cover the present freight, insurance, and other charges, the statistical value is a long way less than the actual landed value."

Home Curing of Bacon and Hams.—The following recipe, which has been used with good results, is published in response to inquiries: Weigh out for each 100 lb. of meat 5 lb. salt, 2 lb. brown sugar, and 2 oz. saltpetre. When the carcase is thoroughly set cut up and salt lightly, then lay it overnight upon a clean concrete floor or table. By salting lightly is meant that as much salt as will cover the meat comfortably without undue waste is used. Next morning brush the salt off thoroughly, then dry-salt the meat with dry salt and brown sugar, rubbed well in daily for three days. On the fourth and fifth days a little saltpetre should be added to the salt and sugar, which should be well rubbed in, especially on the skin. Leave the bacon and hams in the mixture for about three weeks, but they should be turned every day or second day ; at the same time continue rubbing during this period. Then wash clean, when the bacon and hams will be ready for smoking, the duration of which depends upon the taste of the manufacturer. After the first week or ten days it is advisable to brush the salt and sugar off the inner side of the thin parts of the bacon (flaps). The quantities specified of salt, sugar, and saltpetre should cover the whole process. Note that dry-salting should only be undertaken in cold weather and in a cool place.

LAND HOLDINGS IN NEW ZEALAND.

TABLE SHOWING FOR THE YEAR 1919–20 THE NUMBER OF OCCUPIED HOLDINGS (OUTSIDE BOROUGH BOUNDARIES) IN GROUPS OF SIZES ACCORDING TO LAND DISTRICTS, ALSO CORRESPONDING ACREAGES FOR THE DOMINION.

Areas of Holdings (Acres, inclusive).	North Auckland.	Auckland.	Hawke's Bay.	Taranaki.	Wellington.	Nelson.	Marlborough.	Westland.	Canterbury.	Otago.	Southland.	Total Numbers for the Dominion.	Total Acreages for the Dominion.
													Acres.
1–5 ..	1,826	832	965	432	1,637	405	342	132	2,426	1,036	443	10,476	30,565
6–10 ..	1,001	366	597	229	717	243	127	74	985	503	236	5,078	41,626
11–15 ..	555	194	288	136	348	199	75	36	474	267	177	2,749	35,829
16–20 ..	443	177	198	84	263	182	49	27	495	236	125	2,279	42,099
21–30 ..	680	267	244	132	402	265	61	62	585	303	172	3,173	81,583
31–40 ..	517	224	235	95	301	151	36	41	390	236	144	2,370	85,969
41–50 ..	547	457	183	219	351	156	46	53	426	222	136	2,796	131,242
51–75 ..	912	717	276	494	605	213	64	74	630	397	228	4,610	289,193
76–100 ..	957	1,101	309	669	696	237	69	82	608	389	312	5,429	491,244
101–150 ..	1,194	1,409	367	1,015	907	298	100	107	846	606	491	7,340	919,071
151–200 ..	878	1,085	230	744	720	182	86	139	657	484	534	5,739	1,023,181
201–250 ..	571	705	147	462	501	136	68	90	553	383	438	4,054	913,296
251–320 ..	646	741	163	368	482	183	87	120	659	434	563	4,446	1,272,937
321–400 ..	548	592	191	220	442	146	96	84	575	357	409	3,660	1,324,495
401–500 ..	446	530	219	192	408	161	77	79	489	326	346	3,273	1,479,548
501–640 ..	377	497	245	219	449	192	103	56	490	303	302	3,233	1,837,736
641–750 ..	188	217	138	98	232	94	61	37	227	137	117	1,546	1,075,476
751–1,000 ..	238	393	273	180	368	196	92	32	348	241	173	2,534	2,225,816
1,001–2,000 ..	331	496	526	222	661	210	159	56	504	379	223	3,767	5,270,153
2,001–3,000 ..	71	123	208	43	187	31	47	8	181	131	41	1,071	2,620,753
3,001–4,000 ..	32	45	109	12	103	10	34	6	96	75	33	555	1,931,782
4,001–5,000 ..	21	21	79	8	33	12	10	8	49	72	16	329	1,483,045
5,001–7,500 ..	12	27	76	12	60	6	26	15	48	65	21	368	2,246,494
7,501–10,000	5	22	30	3	15	2	16	8	30	40	11	182	1,578,129
10,001–15,000	9	9	20	..	23	1	9	13	30	59	15	188	2,315,826
15,001–20,000	..	5	15	..	11	1	12	7	22	31	7	111	1,919,863
20,001–30,000	1	4	7	..	3	1	8	12	20	26	10	92	2,266,376
30,001–40,000	1	3	2	..	2	..	3	7	15	22	4	59	2,060,704
40,001–50,000	2	1	2	..	..	..	1	4	5	8	..	23	1,044,135
Over 50,000 ..	..	1	3	..	1	1	6	2	24	18	6	62	5,434,913
Totals ..	13,009	11,261	6,345	6,288	10,928	3,914	1,970	1,471	12,887	7,786	5,733	81,592	43,473,079

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SHEEP MAGGOT-FLIES AND THEIR ALLIES.

A NEW ZEALAND INVESTIGATION.

DAVID MILLER, F.E.S., Entomologist, Biology Section.

FOR the purpose of ascertaining what species of maggot-flies are responsible for "blowing" the living wool of sheep in New Zealand an investigation into the problem has been recently undertaken. The matter in the following pages is a preliminary review of the several species of maggot-flies occurring in the Dominion and of the information, so far collected, on the injurious species. In order to facilitate this undertaking a circular letter was sent last spring to a large number of sheepowners throughout New Zealand asking for specimens of maggots in damaged wool. The response to this circular was disappointing, as only some thirty-seven replies and eighteen samples were received. The information derived from these, however, is of great value.

The problem of sheep maggot-flies in Europe, and particularly in Australia, is one of extreme importance to sheepowners in those countries. Although the flies responsible for the injury both in Europe and the Commonwealth are among the most common species of flies in New Zealand, and the conditions of many locations are favourable for the development of their injurious habits, the possibility of these

insects causing more widespread damage to our flocks than they do at the present time is lessened, to a very great extent, by the methods of sheep-management in this Dominion, where close attention to the flocks is generally more practicable than in Australia.

CHARACTERS OF MAGGOT-FLIES.

Maggot-flies are a well-known group of the two-winged insects, and many species play an active and detrimental part in man's economy. The common house-fly, for example, is notorious as a transmitter of such diseases as typhoid fever and tuberculosis; the stable-fly for its habit of "biting" and drawing blood, incidentally transmitting pathogenic micro-organisms; the maggots of some species for their attack upon sheep's wool, and of others for their obnoxious habit of living in the nasal cavities and alimentary canal of vertebrates—man included. The maggot-flies, in the larval or grub state, are primarily scavengers living upon decaying animal or vegetable matter, according to the species of fly. The destructive habits of the injurious species are purely secondary acquirements, encouraged, beyond doubt, though unintentionally, by man himself, since the more favourable breeding-conditions for the maggots—consequent upon an increased population of domestic animals — present a more favourable environment, encouraging an abnormal increase of the insects, than will be found under feral surroundings where the breeding-grounds are limited and the struggle for existence more intense.

The term "maggot-fly" is here applied to such flies as blow-flies, house-flies, stable-flies, and greenbottles, the maggots of which live normally in decaying animal and vegetable matter. The principal characters by which these flies may be recognized are as follows:—

From the front of the head between the two large eyes hang the short antennæ or feelers, from the third joint of which projects a bristle which may be more or less hairy or bare (Fig 1). The mouth is on the under-side of the head, and is enclosed by the base of a fleshy tube, the proboscis (*Pro*), attached to which is a pair of club-shaped and highly sensitive appendages called the palpi (*p*). The proboscis in the blood-sucking flies, such as the biting stable-fly (*Stomoxys calcitrans*), is not fleshy but hard and awl-like, being adapted for piercing the skin of animals for blood-sucking purposes (Fig. 14). The wings present distinctive characters; on each wing are a number of ribs or veins, which are arranged differently in various species, the fourth vein, which may be angulated, broadly curved, or straight, varying most (see Fig. 2 *a*, also wings of Figs. 10, 12, and 13). On each side at the base of each wing is a pair of opal-white or sometimes brownish scales, which are attached to the body and lie between the base of the wings and the abdomen, the base of which they more or less partially cover. Beneath these scales will be found on each side a pin-shaped structure called the halter. In other two-winged insects these scales are either completely or practically absent, exposing the halter. There is a system of well-developed bristles on the thorax (see Fig. 15), but the bristles of the abdomen are rather weak or hair-like or absent.

There is an extensive group of flies the larger members of which very closely resemble such maggot-flies as the bluebottles not only in shape, size, and colour, but also in the angulated fourth vein of the wing. The group is known as the Tachina flies, all of which, as far

as is known, are beneficial, their maggots living upon harmful and other larvæ. The Tachina flies have the thorax and abdomen very strongly bristled, which distinguishes them from the maggot-flies.

The creamy-yellow or opal-white eggs of the maggot-flies are elongate and narrow, widening toward one end (Fig. 3). The young maggots or larvæ hatch through a split in the egg. The legless maggot (Fig. 4) is narrow at the head but broadens to the posterior end, which is truncated; in place of legs is a number of rough pads along the under-side of the body, which serve for purposes of locomotion. Each larva changes to the dark-brown elliptical pupa (Fig. 5), which is the resting-stage within which the tissues of the maggot are remodelled to those of the adult fly. The pupa in due course opens lid-like at one end, and the adult escapes.

THE LIFE-HISTORY OF A MAGGOT-FLY.

The female maggot-fly deposits a large number of eggs, but in some cases and under certain conditions the parent gives birth to living maggots. This is the case with certain bluebottles and more frequently with the yellow blow-fly (*Pollenia stygia*), which in mild weather deposit eggs but in muggy seasons living maggots. The eggs are laid in batches or singly upon decaying animal or vegetable matter. According to the time of the year, the maggots hatch from the eggs in a shorter or longer time, and commence to feed, burrowing in away from the light. The maggots are voracious and feed constantly, rapidly growing; they may devour their fellows when they are very numerous or when the normal food-supply runs short. When a maggot is fully developed it seeks some sheltered spot on the ground and transforms to the pupa. On the adult emerging from the pupa the wings unfold and harden, and the insect flies away.

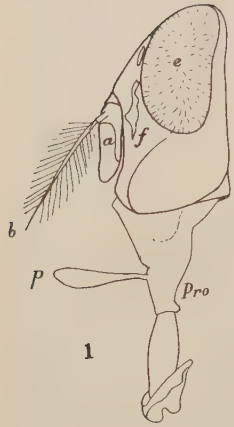
NATURE OF DAMAGE TO SHEEP.

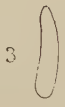
The sheep maggot-flies blow the wool of sheep, particularly when the sheep are allowed to become daggy, although clean wool is also attacked. Wounds and sores, and feet affected by foot-rot, are also attacked by maggot-flies. From observations made in this country and elsewhere sheep are most liable to be blown during wet or muggy weather and in sheltered localities. The maggots on hatching from the eggs work at once through the wool down to the skin, which then festers, causing the wool to rot and become putrid. At this stage other species of maggot-flies, which would otherwise not blow wool, may be attracted and lay their eggs in the decaying mass. The maggots may also burrow into the festering skin and spread the suppuration and decay. According to Mr. J. Milliken, of Cass, sheep that have been attacked by the kea, but not killed at the time, succumb to the ravages of maggots, the wounds attracting the flies.

SPECIES OCCURRING IN NEW ZEALAND.*

There are at least fifteen species of maggot-flies in New Zealand, our being native and the rest exotic; but although all are more or less associated with man, it is certain Australian and European

* The names applied to the native blow-flies in this article have not been altered except in one instance, but a complete synonomy will be published later.





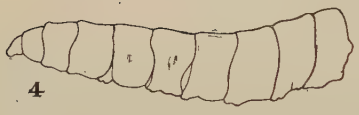


Fig. 1. Head of a maggot-fly in profile, showing—*a*, antenna; *b*, bristle of antenna; *e*, eye; *f*, face; *Pro*, proboscis; *p*, palpus—enlarged.
Fig. 2. Wing of a maggot-fly, showing fourth vein *a*, enlarged.
Fig. 3. Egg of maggot-fly, enlarged.
Fig. 4. Larva or maggot of a maggot-fly, enlarged.
Fig. 5. Pupa of a maggot-fly, enlarged.
Fig. 6. Large native bluebottle (*Calliphora quadrimaculata*), × 2.
Fig. 8. *Sarcophaga impatiens* (species uncertain), female, × 2½.
Fig. 9. Common house-fly (*M. domestica*), × 3.

forms which at the present time are really injurious to sheep. The four native species are all bluebottles—namely, *Calliphora quadrimaculata* Swed. (large native bluebottle), *C. hortona* Walk., *C. icela* Walk., and *Pyrellia antennatis* Hutton (yellow-horned bluebottle). The Australian species are *Pollenia stygia* (*villosa*) Fabr.* (golden-haired blow-fly), *Ophyra analis*, *O. nigra* Wied., and *Sarcophaga impatiens* Walk. The European species, all of which are of world-wide distribution, are *Musca domestica* Linn. (common house-fly), *Muscina stabulans* Meig. (stable-fly), *Stomoxys calcitrans* Fabr. (blood-sucking stable-fly), *Lucilia caesar* Linn. and *L. sericata* Meig.† (two greenbottles), *Calliphora erythrocephala* Meig. (European bluebottle), and *Fannia canicularis* Linn. (lesser house-fly).

The native bluebottles range throughout the country, the most conspicuous being the large native bluebottle (*Calliphora quadrimaculata*), the maggots of which live on a variety of substances besides decaying animal matter. This blow-fly is fairly common in houses, and is notorious for seeking out man even in the remotest parts of the forests and blowing his blankets, clothes, and meat. The writer has observed it blow the shaft of an iron crow-bar which had just been handled.

C. quadrimaculata (Fig. 6), which measures about $\frac{1}{3}$ in. in length, is black on the thorax and has a lustrous violet-blue abdomen; the face is black, and has brick-red markings; the antennæ are black, but somewhat reddish in the middle, and the palpi are orange in colour.

Calliphora hortona is smaller, measuring about $\frac{1}{3}$ in. in length; it resembles *C. quadrimaculata* in form and general colour, but may be distinguished by the shiny blue and slightly green abdomen, the black palpi, and the black face and antennæ, which are without reddish markings. Its maggots live to a very large extent upon seaweed cast up on the coast and upon horse-dung in the field; the adults are to be found sometimes in houses.

Calliphora icela is the smallest native blow-fly, measuring about $\frac{1}{4}$ in. in length. It is coloured as *C. hortona*, but the black face has golden reflections, the black antennæ are slightly reddish in the middle, and the palpi are orange. This species, which breeds in decaying animal and vegetable matter, has not yet been found to attack sheep's wool.

Pyrellia antennatis (the yellow-horned bluebottle) is the fourth native species. It is about the same size as *C. hortona*, which it resembles in colour, except that the antennæ are of a bright orange colour; also the fourth vein of the wing forms a broad curve, and not an abrupt angle, as is the case in the other native bluebottles. This species is not known to be injurious to wool; it has been bred by Mr. J. G. Myers from rotting potatoes.

* This fly has been known in New Zealand for many years as *Calliphora laemica* White, but is now found to be identical with *P. stygia* (*villosa*) Fabr.

† The identification of *L. sericata* and *L. caesar* has been based mainly on the chætotaxy.

Fig. 7. Golden-haired blow-fly (*Pollenia stygia*), female, × 5.
Fig. 15. Greenbottle (*Lucilia sericata*), female, × .

These two species are the most important maggot-flies in New Zealand as regards the blowing of sheep.

The golden-haired blow-fly (*Pollenia stygia**) (Fig. 7), as already indicated, is a native of Australia. Apparently it was introduced into the North Island in the early days of colonization. Hutton observed that this fly appeared in Christchurch in 1874, though it was not then common; but it was not until 1900 that he first noted it at Queenstown; prior to 1879 he had never seen this species in Otago. *P. stygia* is now one of the most abundant of flies throughout New Zealand. The thorax is blackish-grey and the abdomen golden yellow with blackish-yellow areas reflected over the surface, while the fourth vein of the wing is strongly angulated. It is common in houses, and is familiar to every one on account of its habit of blowing meat and blankets. In Australia this fly is a serious menace to wool-growing, and is one of the species responsible for the extensive blowing of living wool in that country. According to Froggatt, *P. stygia* lays on an average 260 eggs, but in the summer months deposits living maggots, though it does not blow sheep in the heat of summer. The habit of depositing eggs in mild seasons and living larvæ in hot weather is also true of this species in New Zealand, but apparently our summers are not sufficiently hot to prevent the fly attacking sheep, as will be seen below.

The two Australian flies, the shiny black fly (*Ophyra nigra*) and the shiny blue-black fly (*O. analis*), occur also in New Zealand. They are flies about the size of the common house-fly, but more robust in build, resembling a small bluebottle. The fourth vein is practically straight, and the latter fly differs from the former in the shiny blue colour and the greyish appearance of the end of the abdomen. These two flies breed normally in decaying matter, but in Australia *O. nigra* has been found to blow sheep.

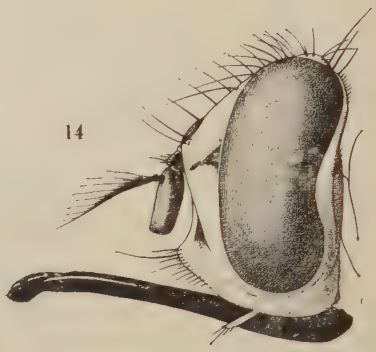
The flesh-fly (*Sarcophaga impatiens*)† (Fig. 8) is one of the most common flies in New Zealand. It is essentially an out-of-door fly, but is seen occasionally in and about houses; it breeds in cow-dung and other decaying matter. The adult is a little larger than a house-fly, and has a yellowish thorax with three black stripes along the back; the abdomen is blackish, and chequered with numerous golden-yellow reflections; the fourth vein of the wing is angulated. This fly occurs during the spring, summer, and autumn upon grass and other vegetation. It may abound in such countless numbers on ripening oats, for example, that the crop may be rendered literally black. This fly is not known to blow sheep in New Zealand.

The common house-fly (*Musca domestica*) (Fig. 9) is well known and easily recognized. It has the fourth vein of the wing angulated, and four dark stripes along the back, while the abdomen is yellowish with blackish markings down the middle. The house-fly is a truly domestic insect; its larvæ live principally in heaps of horse-dung. This fly is well known as a carrier of disease organisms.

The lesser house-fly (*Fannia canicularis*) (Fig. 10) also frequents houses, and resembles the common house-fly to some extent. It is smaller, however, and less robust, while the fourth vein of the wing is practically straight. The abdomen is blackish-brown, with yellowish areas towards the base. The larvæ (Fig. 11) have numerous spine-like

* Formerly called *Calliphora laemica* White.

† Dr. T. Harvey-Johnstone, of Brisbane, informs me that there is some doubt as to the correct name of this species.



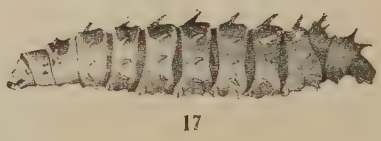


Fig. 10. Lesser house-fly (*Fannia canicularis*), × 4 (after Castellani and Chalmers).
Fig. 11. Larva of lesser house-fly, × 3.
Fig. 12. Stable-fly (*Muscina stabulans*), female, × 3.
Fig. 13. Blood-sucking stable-fly (*Stomoxys calcitrans*), × 3.
Fig. 14. Head of *S. calcitrans* in profile, showing awl-like proboscis, enlarged (after Castellani and Chalmers).
Fig. 16. European bluebottle (*Calliphora erythrocephala*), × 2.
Fig. 17. Larva of *Pycnosoma rufifacies*, × 3 (after Froggatt).

(With the exception of Figs. 10, 14, and 17, illustrations by the Author.)

processes projecting from the body. They breed upon meat and decaying vegetables, and are a common parasite in the alimentary canal of man. This fly has not yet been observed to attack sheep.

The stable-fly (*Muscina stabulans*) (Fig. 12) is a common fly in New Zealand. It is a little larger than the common house-fly, which it resembles somewhat; the abdomen, however, is broader and tessellated with brownish-black and greyish-black; the fourth vein is not angulated but gently curved. The maggots of this fly breed in animal and vegetable matter and have been observed by various authors to attack and live upon the larvæ of the house-fly.

The blood-sucking stable-fly (*Stomoxys calcitrans*) (Fig. 13) is very common in and around stables and in the vicinity of domestic animals in the open. Its proboscis is not a soft tube as in the other maggot-flies, but is in the form of a stout piercing-awl, with which it punctures the skin in order to reach the blood (Fig. 14). It is exceedingly annoying to animals, which when the fly is troublesome will crowd together and move about in a body from place to place in the field. It has been frequently observed by the writer and many others that the common house-fly will accompany *S. calcitrans* and feed at the wound caused by the latter fly. *S. calcitrans* resembles the house-fly to a great extent, but the abdomen is brownish, with darker spots; the fourth vein is not angulated, and the proboscis is adapted for blood-sucking. The maggots live in heaps of horse-manure, and to a limited extent in droppings in the field.

The two greenbottles (*Lucilia sericata* and *L. caesar*) are established in New Zealand. They resemble each other very closely, but the former is of a brilliant coppery colour and the latter brilliant bluish-green. In Europe these flies blow sheep, but in New Zealand *L. caesar* has not yet been bred from damaged wool. The maggots live in decaying animal matter; the adults of *L. sericata* (Fig. 15) are frequently found swarming on carcases upon which they deposit their eggs. In New Zealand *L. sericata* is not common in houses, but in parts of the United States it is usually found in or around dwellings. According to observers this species may lay as many as five hundred eggs. The larvæ have been bred in New Zealand from the wool and wounds on sheep.

The European blow-fly (*Calliphora erythrocephala*) (Fig. 16) is very common in New Zealand, and is one of the first maggot-flies to be on the wing in early spring. It differs from the native *C. quadrimaculata* in the abdomen, being blue with greyish reflections over the surface. This fly blows meat, carrion, and other decaying matter; the larvæ have also been recorded from the intestines of man and animals. In Britain this fly has been known to blow sheep's wool.

In Australia the flies mostly responsible for wool-blowing are the golden-haired blow-fly (*Pollenia stygia*) and a greenbottle (*Pycnosoma rufifacies*), the maggots of which (Fig. 17) resemble somewhat those of the lesser house-fly (*Fannia canicularis*). There is some doubt as to the presence of *P. rufifacies* in New Zealand; in one case "spinose" maggots were found in live wool and burrowing into the skin; but as these larvæ died before transforming to adults, the species, whether *P. rufifacies* or *F. canicularis* or some other, could not be determined.

TABLE OF LOCAL INFORMATION ON SHEEP MAGGOT-FLIES.

The information contained in replies received from sheepowners in response to the circular letter issued, also regarding specimens forwarded by them, has been tabulated as follows :—

No.	Specimens sent by	Locality.	Province.	Sheep attacked.	Date Flies bred out.	Month when Flies blow.	Name of attacking Fly.
1	D. Archibald ..	Spotswood	Canterbury	Lambs ..	9/3/21	Mar. ..	*Lucilia sericata.*
2	J. D. Balfour ..	Tinui ..	Wellington	Lambs ..	..	..	..
				Sheep ..	23/12/20	Dec. ..	*Pollenia stygia.*
3	W. E. Barber ..	Foxton ..	Wellington	Lambs ..	..	Dec. ..	..
4	Chaytor and Co.	Marshlands	Marlborough	Lambs and cast sheep	..	Sept. onwards	..
5	J. Grant ..	Rotorua ..	Auckland ..	Lambs ..	22/12/20	Dec. ..	*Pollenia stygia.*
6	J. C. M. Greensill	Pelorus Sound	Marlborough	Lambs ..	..	Sept. onwards	..
7	G. Haycock ..	Richmond	Nelson ..	Lambs ..	..	..	Greenbottles(species uncertain).* Bluebottles (species uncertain).*
8	J. W. Hayes ..	Waimate..	Canterbury	Lambs ..	24/2/21	Jan. onwards	*Pollenia stygia.*
9	H. G. Humphries	Hokianga	N. Auckland	Lambs ..	..	..	*Pollenia stygia.*
10	J. W. T. Jones	B. of Islands	N. Auckland	Lambs ..	..	..	..
11	P. H. Johnson..	Springfield	Canterbury	Lambs and hoggets	..	Aug. to autumn	..
12	W. McAlpine ..	Craigieburn	Canterbury	Hogget .	..	..	..
13	W. J. A. McGregor	Mount Linton	Southland..	Cast ewe	..	Nov. ..	Bluebottles (species uncertain).*
14	J. A. McLean ..	Masterton	Wellington	Lambs ..	24/2/21	Summer	*Pollenia stygia.*
15	R. McLeod ..	Pepepe ..	Auckland ..	Lambs ..	8/12/20	Nov. ..	*Lucilia sericata* (very abundant). *Pollenia stygia* (a few).
16	E. B. Millton ..	Rangiora..	Canterbury	Ewe lambs	..	Jan. ..	..
17	J. Morrison ..	Hikurangi	N. Auckland	Sheep and lambs	3/12/20	..	*Pollenia stygia.*
18	A. G. Mowat ..	Mokau ..	Taranaki ..	Lambs ..	..	Nov. ..	Bluebottles (species uncertain).* *Pollenia stygia.**
19	T. Nestor ..	Otane ..	Hawke's Bay	Lambs ..	3/2/21	..	*Pollenia stygia,* 62·5 per cent. *Lucilia sericata,* 37·5 per cent.
20	H. V. O'Burne	Hillwood..	Nelson ..	†	..	Jan. ..	..
21	A. D. Rutherford	Blenheim	Marlborough	Merino ewe	7/1/21	Nov. to April	*Pollenia stygia.*
22	J. Stevenson ..	Flaxton ..	N. Canterbury	Merino ewe, lambs and heavy-woolled lambs	7/2/21	Dec. to Mar.	*Pollenia stygia* (4 per cent.). *Lucilia sericata* (96 per cent.).
23	E. Sparrow ..	Takaka ..	Nelson ..	Sheep and lambs	..	..	Bluebottle (species uncertain).* Greenbottle (probably *L. sericata*).*
24	E. E. Vaile ..	Waiotapu	Auckland ..	Cast sheep, wethers, and lambs	..	Nov. onwards	..
25	A. B. Williams	Waipiro Bay	Auckland ..	..	..	Nov. ..	..
26	A. L. Williams	Hoanga ..	N. Auckland	Lambs ..	..	Spring onwards	..
27	F. Whitwell ..	Wakapuaka	Nelson ..	Lambs ..	..	Feb. ..	..
28	..	..	..	..	30/2/21	..	*Lucilia sericata.*
29	..	..	..	..	5/3/21	..	*Pollenia stygia* (98 per cent.). *Lucilia sericata* (2 per cent.).
30	..	..	..	..	23/2/21	..	*Pollenia stygia.*
31	W. S. Goodall..	Kaikoura	Marlborough	Sheep ..	..	..	*Pollenia stygia.** *Calliphora quadrimaculata.*
32	..	Oamaru ..	Otago ..	Lamb ..	14/3/21	Feb. ..	*Lucilia sericata.**
33	..	..	..	..	2/2/18	..	*Lucilia sericata.* *Calliphora hortona.*
34	..	..	..	..	..	..	Spinose maggots (species uncertain)
35	J. Milliken ..	Cass ..	Canterbury	Ewe lamb	..	Throughout season	Not yet bred out.
36	Badger Bros. ..	Eltham ..	Taranaki ..	6-tooth ewe	..	..	Not yet bred out.

* Not actually bred out. † Maggots died.

Remarks by Correspondents.

No. 2.—Although there have been many dirty sheep this season (1920–21), no lambs have been found blown and only two sheep. In the past both sheep and lambs have been badly blown.

No. 3.—Blowing most prevalent after Christmas, and a few lambs are lost each year. Owing to hot weather wool-blowing has been worse this season (1920-21)

No. 4.—Flies are most troublesome when lambs commence to eat grass; cast sheep at lambing in early spring are also blown. Dipping lambs during November and early December has been found to give good results.

No. 6.—Ewe lambs more susceptible to attack than wether lambs, while large sheep are practically immune. The fly is on the wing in December and blowing occurs during this month. Several deaths due to blowing occurred in January, and at the end of that month fifteen out of seven hundred lambs were struck. If the lambs had been mustered early in January there would have been practically no loss (1920–21). In late November (1919) the lambs were crutched and there were no losses, though prior to crutching the losses were considerable.

No. 7.—Only lambs are struck, not grown sheep. The greenbottles strike first, and, the wool becoming putrid and odoriferous, the bluebottles blow the infected parts. Shearing the lambs has been found to prevent the flies attacking.

No. 8.—Lambs blown about the tail, the maggots working up on to the rump; older sheep not attacked.

No. 9.—The fly is bad, particularly on damp or dirty wool from docking-time onwards; only lambs attacked.

No. 10.—Flies blow clean wool on shoulder and loins.

No. 11.—Hoggets fed on turnips during August and September were struck on the tail and penis, though the weather was cold and frosty; blowing also occurs in autumn. Crutching and dipping are beneficial.

No. 12.—Hoggets running on the ranges were attacked; blown sheep not common this season (1920–21).

No. 13.—Not troubled with maggot-flies, though bluebottles have been observed to blow a cast ewe which had been down for some days before shearing.

No. 14.—Lambs particularly are considerably attacked during summer.

No. 15.—Owing to the weather not being warm this season (1920–21) there has not been much damage, but in damp, hot weather greenbottles are very troublesome to lambs.

No. 16.—Ewe lambs first attacked during January. An arsenical powder dip used during December acted as a preventive.

No. 17.—Flies blow blood on lambs at docking. Sheep are blown during mild winters and in summer.

No. 18.—Flies not very troublesome. Occasionally the blood of late-docked lambs is blown; flies have not been noticed to strike on the body. Greenbottles have not been seen; bluebottles and the yellow blow-fly were the only ones observed.

No. 19.—Only lambs are blown but not extensively, the climate being dry and windy; in sultry weather the flies are more prevalent. Blowing is prevented by shearing, crutching, and dipping; a poisonous dip has been found more efficacious than a non-poisonous one.

No. 21.—Flies active in muggy weather and in low-lying swampy gullies. The blowing is most prevalent during November and December, and again in February, and particularly during March and April. During January and February the wool is short and clean after shearing, which probably accounts for the absence of extensive blowing. Four years ago, in all parts of the Mount Gladstone district flies struck round rams' horns during April, but since then this has happened only occasionally.

No. 22.—Flies increasing every year, and commence to attack about Christmas until end of March. Lambs, particularly long-woolled and Merino ewe lambs, where the wool is stained with urine, are especially attacked. If lambs are not crutched fully 50 per cent. will be infested.

No. 23.—Maggot-flies have been troublesome for the past sixty years. The bluebottle has been observed in the act of depositing eggs in the wool of daggy sheep and lambs. Some years ago a bronzy-greenbottle fly, very active and difficult to observe, was noticed among the sheep, but was not observed to strike. The bluebottle is without doubt the culprit. Ewes at lambing-time are blown, and sheep, if not crutched, will be blown at any time of the year.

No. 24.—Maggot-flies not very troublesome. They are most prevalent in moist seasons during November, while lambs, particularly weakly lambs, are

attacked most frequently from December onwards. Cast sheep are also attacked and maggots have been taken from the belly of a wether.

No. 25.—Flies worst during November, particularly in wet seasons.

No. 26.—Lambs are attacked after weaning. Blowing occurs also in February, and two different kinds of maggots have been observed at work.

No. 27.—Lambs are blown in February, but if sheep are crutched and kept reasonably clean they are not attacked to any extent. Lambs are more susceptible than older sheep.

Nos. 28, 29, and 30.—Locality and sender unknown.

No. 31.—Flies frequently observed flying about blown sheep.

No. 32.—Flies not serious. Specimens taken from a daggy lamb.

No. 35.—Sheep, particularly when cast or dirty, are blown throughout the season, but flies are worst from Easter to end of June, especially in damp seasons. Infestation is controlled to a great extent by crutching and dipping. Sheep attacked by the kea, but not killed, succumb to the attacks of maggots.

No. 36.—Infested wool taken from the breech of a six-tooth Romney-Lincoln ewe. The maggots had burrowed into the skin on the left thigh to a depth of about 1 in.; in this hole, which measured about 2 in. long by 1 in. wide, was a great number of maggots.

SPECIES ATTACKING SHEEP IN NEW ZEALAND.

From the foregoing tabulated information it is apparent that the flies most responsible for wool-blowing in New Zealand are the golden-haired blow-fly (*Pollenia stygia*) and the greenbottle (*Lucilia sericata*), the former being by far the most frequently met with. Both these species are not only found unassociated, but often associated in varying proportions on the one sheep, *P. stygia* being sometimes in excess of *L. sericata*, and *vice versa*. In such cases there is nothing as yet to show whether one or the other was primary or secondary, or whether each struck independently.

Several references are made to bluebottles attacking sheep, but it is noteworthy that only on one occasion has a bluebottle (the native *Calliphora hortona*) been bred from wool, which was daggy. With the exception of *C. hortona*, the names of the bluebottles referred to are not yet ascertainable; but in view of the fact that the European blow-fly (*C. erythrocephala*) strikes sheep in Britain, and that it is such a common fly in parts of New Zealand, it is probable that this fly and the large native blow-fly (*C. quadrimaculata*) on rare occasions, or under exceptional conditions in certain localities, do strike sheep, particularly if these animals are cast or very dirty. Mr. Sparrow (No. 23) has actually observed bluebottles (species uncertain) to strike daggy sheep and lambs. It is quite possible that these flies are *C. quadrimaculata*, since observations made over that district (Takaka) during 1911-12 by the writer showed that *C. quadrimaculata* was the most abundant bluebottle. *C. hortona* and *P. stygia* were also frequently met with, while *L. sericata* was not at all prevalent, and *C. erythrocephala* was uncommon. The native bluebottles were common throughout the winter.

Though the primary damage is apparently mostly due to *P. stygia* and *L. sericata*, it is probable that the bluebottles are attracted to and strike the already infested wool; one observer (No. 7) has noted bluebottles to attack wool already blown by *L. sericata*.

As already stated, spinose maggots were found on one sample, infesting the wool and burrowing into the skin, but as the maggots died the adults were not bred out. These larvæ may have belonged to the lesser house-fly (*Fannia canicularis*), which is a very common fly in New Zealand, or to *Pycnosoma rufifacies*, the adults of which, however, have not yet been definitely identified in the Dominion.

SHEEP MOST SUSCEPTIBLE TO ATTACK, AND PREDISPOSING FACTORS.

From available information there is no doubt that lambs suffer most from maggot-flies, and large sheep very little, except ewes at lambing or sheep uncrutched or cast. Of the lambs, ewe lambs, particularly where the wool is damp and dirty, are more liable to be blown than wethers; flies are also attracted by blood at docking-time, and have also been known to strike round the horns of rams. At times clean sheep may be blown about the shoulders, but most of the damage is done to dirty animals. Dog-bites and other wounds are blown, as well as decaying feet in foot-rot.

In Australia, where annual loss through maggot-fly depredation is very great, wool-blowing has become very much worse in recent years, clean wool being now extensively infested. This is probably due, to a large extent, to the blowing habit of the maggot-flies becoming more widely established, to the abnormal increase of the flies themselves, and to the difficulty of giving close attention to the flocks. The fact that greasy wool is more affected and that Merinos are shown to be specially susceptible to attack are other predisposing causes in the Commonwealth. In general, many factors (upon which observations are being made) have a decided influence upon fly-attack. Outstanding among such influences are the distribution of the species of flies and breeds of sheep, and the variation in the nature of the wool brought about by climatic conditions.

PERIOD OF FLY ACTIVITY.

In some parts of the Dominion, such as Takaka (Nelson District) and Hokianga (North Auckland), maggot-flies are liable to strike dirty sheep throughout the winter, but blowing becomes most prevalent during the lambing season in the spring, particularly at docking-time and when the lambs just commence to eat grass. The flies are more troublesome in sheltered locations, such as low-lying swampy valleys, and during moist and hot seasons, than in exposed localities and during dry weather. Blowing continues through December until the autumn, though where the sheep and lambs are clean after shearing there may be a period of immunity during January and February. One observer (No. 35) states that the worst period of fly-activity is from Easter to end of June, particularly when the weather is at all damp.

FACTORS IN CONTROL.

The consensus of opinion points to the fact that when sheep and lambs are kept clean by crutching and dipping fly-attack is controlled to a very great extent. Lambs crutched in late November were afterwards free from attack although there was considerable infestation before crutching; the shearing of lambs was also effective. Dipping gave good results, an arsenical-powder dip being apparently more effective than a non-poisonous one.

Control experiments* carried out in Australia show that poisonous specifics are the most effective, and that crutching gives good results at the time, but cannot be relied on for a longer period than three months. Sheep when sprayed with poisonous dips every three months, the spray being applied under a pressure of 120 lb. to the square inch,

* W. G. Brown, *Queensland Agricultural Journal*, Feb. 1919.

have been found to be less subject to attack. In such cases the sheep are run through a race 3 ft. in width and 50 ft. in length, three men being able in this way to handle two thousand animals a day. Considerable care must be taken in spraying sheep, since a mixture which is harmless when applied to the surface of the wool may be injurious if forced, under pressure, on to the skin of the animal. Froggatt states that a mixture used for surface application must be diluted two-thirds before being used on the skin. Crude arsenic has been found to destroy flies and their maggots, but the effect of arsenic upon the sheep is not known. Dipping sheep in a poisonous dip up to eight months after shearing rendered the wool immune to maggot-attack. Unhealthy sheep and densely woolled breeds, particularly when wet or dirty, suffer most, Merinos being more susceptible than crossbreds, while maiden ewes are liable to be struck most of all. Froggatt states that care should be exercised when clipping off infested wool from a blown sheep, since during the operation the maggots are liable to migrate on to the adjoining healthy parts. To prevent this a clear space should first be shorn around the infested part

One of the most important methods of control is to destroy the normal breeding-grounds—carcases of animals—by burying or burning, and so lessen the prevalence of the flies. It is a practice in Australia to use dead animals as a bait to attract the flies and upon which they lay their eggs and maggots, the carcase being then burned or buried.

In Australia and Britain considerable attention has recently been given to the insect parasites of maggot-flies. It has been found that the latter are attacked by several species of parasites, the utility of which, however, as a means of control has not yet been definitely proved. Large numbers of one of these parasites (*Chalcis calliphorae*) were secured from Australia by the writer some two years ago, and liberated in New Zealand, but no definite results have yet been attained. Professor H. B. Kirk, of Wellington, has found that the larvæ of the common house-fly were parasitized by what is apparently a chalcid, but no specimens of this parasite are at present available for determination. This aspect of control is being gone into, and it is hoped to successfully introduce and establish certain of these parasites in the Dominion.

REQUEST FOR SPECIMENS AND INFORMATION.

In order to aid the sheep maggot-fly investigation it is desirable to secure living specimens on infested wool from all parts of New Zealand. Maggots carry well upon the infested wool if placed in a tin. Specimens of adult flies of any description whatsoever are also of much importance; these may be sent dead in some receptacle which will not be crushed in transit. Flies are readily suffocated with tobacco-smoke. Any such specimens would be of very great value. Notes on any or all of the following points are also essential, even from localities where wool-blowing is not prevalent:—

(1.) Breed, sex, age, and part of sheep attacked.

(2.) Time of year when blowing is most prevalent.

(3.) Locality description, whether land elevated or low-lying, open or sheltered; and any remarks on seasonal climate.

(4.) Percentage of mortality due to maggot-flies, and whether fly-attack is on the increase or decrease.

FINELY GROUND RAW PHOSPHATE.

NOTES AND OPINIONS ON ITS USE IN AGRICULTURE.

ALBERT F. ELLIS, New Zealand Phosphate Commissioner.

THE question as to whether phosphate can economically be used in its raw state, or whether it should be used only in the water-soluble form of superphosphate, has been under consideration for many years. It appears that up to comparatively recently the advocates of the chemically treated article were gaining ground. This may possibly be because the latter is quicker in its action, or because the raw phosphate was not ground fine enough. With modern machinery, combined with the system of air separation, the material can, without undue expense, be ground to an impalpable powder.

Recently the increasing demand for basic slag in England, together with its decrease in quality, has turned attention back to the finely ground raw phosphate, which is considered to be probably the best substitute for basic slag. In that connection the matter becomes of interest to New Zealand, where slag has been in high favour for top-dressing purposes.

In order to get the latest information from some leading agricultural authorities I have exchanged views with them, either by interview or by letter, and may briefly state these, together with extracts from some of their recent publications. In leading up to the question with them I stated our experience in New Zealand briefly as follows: On soils with a sour tendency, or fairly rich in humus, and in districts where the rainfall is satisfactory, finely ground raw phosphate gives good results, particularly when used for top-dressing.

BRITISH EXPERIENCE.

Experience in the United Kingdom may be considered of particular value to us, as the rainfall there is somewhat similar to ours, while we have the advantage of warmer climatic conditions. The views ascertained there either by interview, letter, or from publications are contained in the matter which follows.

Dr. E. J. Russell, Director of Rothamsted Experimental Station.

We discussed the matter, and I found that he endorses our experience in New Zealand. He looks forward to the fine-ground phosphate being of particular service in view of the basic-slag position, and said that he is going to inaugurate a series of experiments with the former at Rothamsted.

In his book "Manuring for Higher Crop Production" (1917) Dr. Russell states:—

> "Mineral phosphates: Such experiments as have been made indicate that they give good results when ground sufficiently fine, and when immediate action is not necessary. . . . Experience shows that they do not help the young plant very much; the braird is considerably below that obtained with superphosphate or slag.

This difficulty can be overcome by mixing with a certain proportion of superphosphate; the seedling-stage is thus assisted, and the older plant can then make use of the mineral phosphate. . . . In the warmer, moister region of North Wales it seemed unnecessary to add superphosphate, the phosphate by itself giving satisfactory increases."

Professor James Hendrick, College of Agriculture, Aberdeen.

The following is an extract from a letter from Professor Hendrick:—

"I am glad to say that our results agree generally with those which have been obtained in New Zealand. The soils of this area are generally deficient in lime and tend to be sour. There is also, generally speaking, a considerable proportion of humus in the soil. I expect that in the future it will be much more difficult to obtain supplies of basic slag. In my opinion ground rock phosphate might be used to a large extent to replace basic slag."

In an article published in the *Journal of the Society of Chemical Industry* for 1919, after detailing some field experiments, Professor Hendrick states:—

"The general result of the experiments is to show (1) that the average effect of superphosphate is only slightly greater than that of insoluble phosphate, such as basic slag or ground mineral phosphate, when equal weights of phosphoric acid are applied; and (2) that if one-third of the phosphoric acid is given as soluble phosphate and the remainder as insoluble phosphate, the average result is as good as when the whole of the phosphoric acid is given as soluble phosphate. Experiments with other crops, and especially with grass, give a similar result.

"The only conclusion one can come to is that soluble phosphate is overvalued, and insoluble phosphate such as exists in basic slag and ground mineral phosphate undervalued. It should be possible in future to use a large part of the rock phosphate in the form of finely ground powder instead of in superphosphate. This will effect a great saving in acid and in expense."

Professor Douglas A. Gilchrist, Armstrong College, Newcastle-upon-Tyne.

Extract from letter:—

"I am very much struck with the work of Dr. Hopkins, in America, on mineral phosphate. I feel sure that, provided we get the mineral phosphates ground finely, they can be used to a very considerable extent."

Extracts from publications regarding experiments:—

"It has long been known that many mineral phosphates, when finely ground, are valuable phosphatic manures. These trials show that when such mineral phosphates are as finely ground as basic slag the phosphates they contain may be equally effective.

"Mineral phosphates deserve more attention from the experimenter and the farmer. Their cost per unit of phosphate of lime is considerably less than that of basic slag. Both Tunisian phosphate and Belgian phosphate have given quite satisfactory results."

Dr. G. S. Robertson, East Anglian Institute of Agriculture, Chelmsford.

Extract from letter :—

"Our experience with rock phosphate agrees in general with the remarks which you make. I find that on sour soil well supplied with organic matter and where the rainfall is rather high—say, about 30 in.—there is little to choose between the various rock phosphates, and that they are all as efficient as the best types of basic slag. Where, however, the soil is sweet and the rainfall about 20 in. to 22 in. they are not so effective as superphosphates or the best grades of basic slag. . . . Where the soil is deficient in lime I am certainly of opinion that these rock phosphates will give more satisfactory results than superphosphates."

Extract from publication, 1916 :—

"Ground mineral phosphate costs from 8d. to 11d. per unit of phosphate, whereas basic slag costs 2s. per unit. If the phosphates in rock phosphates are as efficient as those in basic slag—and there is every reason to suppose they are—their economical importance is obvious. It is interesting to note that in the United States of America mineral or rock phosphates are used almost to the exclusion of basic slag. There can be little doubt that, as a source of phosphoric acid for the plant, rock or mineral phosphates are just as valuable as basic slag."

UNITED STATES EXPERIENCE.

The position in the United States as regards the use of raw phosphate is somewhat remarkable. In the State of Illinois a very vigorous propaganda has been carried out by the Agricultural Experiment Station in favour of the finely ground raw phosphate, not only on account of its immediate beneficial results, but as being conducive to permanent soil-fertility. It is stoutly maintained that the use of superphosphate, or acid phosphate, as it is called there, acts as a stimulant to the soil, and tends ultimately to destroy its fertility. The principal advocate of this theory was the late Dr. Cyril G. Hopkins, who has written a number of publications dealing with the subject. As a matter of interest I wrote to the Director of the Experiment Station recently, inquiring if those views are still held. The following reply was received under date 2nd December, 1920 :—

"The Illinois Agricultural Experiment Station has not changed its attitude in regard to the use of raw rock phosphate for soil-improvement. We discourage the use of acid phosphate ('super') for the permanent improvement of Illinois soils. The large number of soils experiment fields which we have conducted in the State for some time, and the increasing number of farmers in the State who are using it, strongly attest to its value. The farmers of the Illinois corn-belt are finding that raw rock phosphate enables them to get much better stands of clover and other legumes, and is one insurance of success in the growth of legumes; improvement in the other crops which follow the legume crops is evident everywhere."

I may say that Dr. Russell, of Rothamsted, informed me that he had been over a large portion of Illinois in company with

Dr. Hopkins, and was much impressed by the work done with finely ground raw phosphate.

At the same time it is remarkable that only two or three of the other States appear to have had similar experience at their agricultural stations, and then only to a minor extent. It is probable that in the districts referred to the soil is more or less sour and somewhat high in organic matter, in which case the carbon dioxide in the soil-water would sufficiently act on the raw phosphate for the requirements of plant-growth.

Bureau of Soils Publication.

The United States Bureau of Soils has issued an official publication dealing with the question of the use of raw phosphate, and while much of the evidence given is in its favour, the summary of results is inconclusive. A few extracts may be quoted from this as follows:—

"Much doubt and difference of opinion exists concerning the fertilizer-value of ground raw rock phosphate, but the use of this material has slowly increased until the annual consumption in the United States is now in excess of 91,000 tons.

"The fineness to which rock phosphate is ground has been found to have a very important influence on its solubility in certain conventional solvents as well as upon its availability to crops.

"In order to determine the sentiment towards ground raw rock phosphate as a fertilizer, a letter and set of questions were sent to each of 1,000 progressive farmers who had used the material for one or more years. Out of 315 replies, 219 farmers, or 69·6 per cent., were favourable to its use; 55, or 17·5 per cent., were doubtful concerning its value; and 41, or 13 per cent., regarded the material unfavourably.

"The application of liberal and even medium quantities of raw rock phosphate to most soils produces an increase in the yields of many crops the first year.

"Most crops respond more quickly to applications of acid phosphate than to bone, basic slag, or raw rock phosphate. Therefore, where the early stimulation and quick maturity of the crop are the main considerations, acid phosphate is probably the best form of phosphoric acid to apply.

"The question whether increases in yield can ordinarily be produced more economically by applications of the soluble or relatively insoluble phosphate must be considered in a measure a separate problem for each farmer, since it depends on a number of factors of which the most important are the nature of the soil, the crop system employed, the price of the various phosphates in each particular locality, and the length of the growing season."

When at Washington last year I had the opportunity of discussing these questions with Professor Milton Whitney, who is in charge of the Bureau of Soils, and Mr. W. Waggaman, one of the authors of the publication just quoted. The former was favourable to acid phosphate rather than the raw phosphate, and held the opinion that Dr. Hopkins was biassed in favour of the finely ground raw phosphate. Mr. Waggaman had an open mind on the matter. He expressed great appreciation of Dr. Hopkins's work, and considered that the use of the two forms of phosphate was a matter for further investigation.

CONCLUSIONS.

In investigating the question under review the following conclusions have been arrived at as having a bearing on agriculture in New Zealand:—

(1.) Finely ground raw phosphate may be considered a satisfactory substitute for basic slag—that is, in those districts where there is usually a sufficient rainfall to ensure that the solubility of the raw phosphate will not be unduly retarded.* In soils which have a sour tendency, as is frequently the case here, or where there is a good proportion of organic matter or humus present, conditions may be considered most suitable for using the raw phosphate. It can invariably be used for top-dressing grasslands.

(2.) For cropping purposes a mixture of superphosphate and finely ground raw phosphate in the proportions of one of the former to two of the latter, or else "half-and-half," is usually as effective as superphosphate alone, while the beneficial effects extend over a longer period. The water-soluble phosphate present is of immediate value to the young plant; its root-system is speedily developed, and as it matures the less soluble phosphate can be dealt with. This mixture combines the advantages of both the fertilizers referred to, while any possible drawbacks to either would be minimized. If prepared from Nauru or Ocean phosphate it would supply more phosphoric acid per ton than any other phosphatic fertilizer except the pure ground raw phosphate. It has been ascertained by experiment that the soluble phosphate (monocalcic) does not revert to the dicalcic form in this mixture. The reverse is the case with mixtures of superphosphate and basic slag.

(3.) In cases where vegetable matter is turned under, raw phosphate can suitably be used, as the bacteria present under such conditions and the carbon dioxide in the soil-water render the phosphate available.

(4.) It is probable that under most soil conditions in the Dominion a policy of developing the humus content of the soil and using more raw phosphate than superphosphate would do more to maintain permanent fertility than is the case where superphosphate alone is relied on. But different results are obtained under varying conditions, and it is a matter for investigation at the experimental stations and by the individual farmers as to which conditions favour the use of superphosphate, finely ground raw phosphate, or a mixture of the two. These classes of phosphate should not be considered as being in opposition, and as a subject for controversy; each has its particular use and will always be required in the Dominion. It remains to be demonstrated just when the one should be used and when the other.

(5.) Beneficial results from the use of finely ground raw phosphate depend very largely on the grinding, which should be to the same fineness as basic slag, or at least 80 per cent. passing through a sieve of 100 holes to the linear inch. Users of the material should stipulate for this state of fineness when placing their orders.

* There is reason to think that a somewhat higher rainfall is necessary in New Zealand for the successful use of raw phosphate and basic slag than is the case in England, where the rainfall is better distributed. The best results are obtained here in districts where the rainfall is from 40 in. to 70 in. Where it is below 40 in. probably superphosphate is the best form in which to apply a phosphatic fertilizer.

(6.) It is generally known in England that the quality of basic slag has materially fallen off of late years, owing to the steel-manufacturers changing over from the Bessemer to the open-hearth method of manufacture. The United Kingdom quota of Nauru/Ocean phosphate has, with the authority of the Ministry of Agriculture, been sold for a year to a basic-slag company for the purpose of grading up their slag. While doubtless this is a beneficial procedure for the users of basic slag in England, it cannot be so for the New Zealand user, as a heavy freight is incurred on the phosphate rock in sending it to England and bringing it back here in the form of basic-slag mixture. Obviously, the better course is to use here the local production of superphosphate and finely ground raw phosphate prepared from the high-grade deposits at Nauru and Ocean Islands in which the Dominion has purchased an interest. By buying from the local works their output goes up and their cost of production comes down, with the result that a reduced selling-price to the users of the fertilizers can be brought in.

LEMON-CULTURE.

DIRECTIONS FOR NEW ZEALAND GROWERS.

J. A. CAMPBELL, Assistant Director of the Horticulture Division, and W. H. TAYLOR, Horticulturist.

For many years lemon-trees have been growing in various parts of New Zealand, but only during the last few years has planting been carried out on a sound commercial basis. It was inevitable that much of the earlier planting should result in failure—being of an experimental nature, this was to be expected. It is now definitely known that lemons can be profitably produced in the Dominion, and there is every reason to believe that in the near future lemon-culture will develop into a useful industry, and that considerable areas in the northern districts will be thus utilized.

Among the essentials for the cultivation of citrus fruits are a comparatively warm climate, absence of extreme winter conditions, a fair rainfall without long periods of drought, fairly good soil with a subsoil that will allow of deep rooting, and perfect drainage. In many parts of the Dominion there are isolated places where lemons can be, and are, grown very well; but it is in the North only that anything like large areas can be found suitable for this fruit. Very rich soil is not desirable, as it engenders leaf-growth at the expense of the fruit. Medium rich soil is best, but comparatively poor soil will answer very well, provided other conditions are suitable. The trees are evergreen and are never really dormant; they do not rest during winter as do deciduous trees. The trees may be termed heavy-headed—that is to say, there is a considerable head of foliage to be maintained throughout the year. Thus there is a demand for a considerable amount of moisture during the summer months, and in winter a state of soil that will conform to the comparative activity of the roots. With citrus fruits deep-rooting is characteristic, and the subsoil should be of a nature that will encourage this habit. It should be loose, and either naturally well drained or capable of being

thoroughly drained by artificial means. No shallow soils, heavy clay soils, swampy soils, or soils that have a hard-pan or impervious clay subsoil are suitable for citrus-culture. The soil should be in such a condition that water will not lie on it even during heavy rain.

When selecting a site the possibility of occurrence of spring frosts should be considered. The best positions generally are the slopes of low hills with easy grades, or level land not locked by hills. Hollows, gullies, and positions where fog lies heavily should be avoided.

VARIETIES AND STOCKS.

The varieties that are most promising are Villa Franca, Lisbon, and Eureka. Of these three varieties possibly Villa Franca will prove the best. Trees raised from cuttings should not be planted, as they appear to be most subject to the canker disease. What makes the best stock is not yet fully determined; some have favoured the sour orange, others lemon-stocks. Despite susceptibility to collar-rot, the latter is now becoming most popular. Pips are saved from selected trees that exhibit a strong and healthy growth. Some species of the lime are being tested at the Tauranga Horticultural Station, and there are indications that these will make the best stocks for use in this country. Much more experimental work will have to be done before this matter is finally settled.

SELECTING THE YOUNG TREES.

Success is largely dependent on the quality of the young trees. Although the importance of planting nothing but strong thrifty trees is well recognized in orchard establishment generally, this factor apparently applies with even greater force to citrus-culture. It is extremely difficult to establish a poor tree; therefore only thrifty well-rooted trees, showing well-coloured healthy barks, should be selected.

Citrus stock should be budded as soon as the wood has reached the proper dimensions, whether this be two, three, or four years from the time the pip is sown. It is as much a mistake to endeavour to raise a tree from a weak stock of small dimensions as it is to expect to get a satisfactory tree from an old stock headed down. The latter should be rejected, and the former accepted only in those instances where sufficient clean new growth has been made in the first season to enable the head of the tree to be formed at the proper height from the ground. A lead-pencil is often referred to for illustrating the size of stock-wood desirable, but a stock of this size cannot be relied upon to produce the growth required. Mr. J. H. Davidson, Manager of the Tauranga Horticultural Station, in a recent article on the subject* recommends a $\frac{3}{4}$ in. stock for budding, and there is little doubt that a stock of such dimensions will be found to give more general satisfaction than one of smaller measurement.

PREPARATION OF THE LAND.

Spring planting—in August and September—appears best where a fair amount of spring rain can be relied on, increasing warmth in the soil favouring the formation of growth and consequent new roots.

* Published in the *Journal* for April last.

Where, however, the normal spring rainfall is deficient it may be best to plant in autumn—April or May.

No planting should be done until the whole area is properly prepared. No greater mistake can be made than to plant trees with the intention of making the necessary improvements afterwards; in very few instances is it possible to do this thoroughly, and it might easily lead to failure in cases where success should otherwise have been assured. If there is scrub growing on the land it should be grubbed and burned. It is wrong to plough woody matter into the soil, as this material is liable to breed fungus diseases, and may do a great amount of harm. If there is a sward of grass the first ploughing should be shallow—just below the roots. The furrows should be broken down with a heavy harrow and left for a few weeks. If couch-grass roots are present they should be grubbed and harrowed out before the next ploughing. If there are no couch-roots the land should lie till the turf is dead, then be deeply cross-ploughed. The soil should be thoroughly worked and brought to a fine tilth. It is a good plan to devote a whole season to the preparation of the soil. A crop of potatoes, followed by lupins, would leave the soil in perfect condition for planting. The cultivation necessary for the potatoes breaks up the soil and suppresses weed-growth, and lupins supply a good body of humus.

Good drainage is essential to successful citrus-culture, therefore drainage must be considered together with the preparation of the land. A satisfactory drainage-scheme should be devised, and the necessary drains laid down before the planting of potatoes or other crops above referred to is undertaken. If, however, the proposed site is so naturally wet as to require excessive drainage, or should perfect drainage be impracticable, the project should be abandoned and the land utilized for other purposes for which it may be more suitable.

PLANTING.

The trees should be planted 25 ft. apart, on the square system, requiring sixty-nine trees to the acre. The sites for the trees should be marked by pegs, and the holes dug a week or two before planting. The soil from the holes should be scattered broadcast, not piled around the holes. Two or three handfuls of ground limestone (carbonate of lime) should be worked at this time into the soil at the bottom of each hole. At the time of planting two handfuls of blood-and-bone should be similarly worked into the bottom of each hole.

The roots of the young trees should be examined, and damaged parts cut off. In the process of transplanting there is always some loss of roots. The tops should be lightened to make up for this loss, as it would be difficult to re-establish a tree with a head heavy in proportion to the roots. This may be effected by removing superfluous branches—three main branches being sufficient to make the foundation of a tree—or by shortening growths, as the case may require. Pot-grown trees have sometimes to be dealt with. In such cases it is necessary to disentangle the roots, and unless the soil can be easily removed the ball should be immersed in water and all the soil washed away. The roots can then be spread out in a proper manner. When

a young tree is furnished with spreading roots a mound should be made in the centre of the hole on which the tree should be placed with the roots pointing down the sides of the mound. Tread the soil firmly over the roots, but leave the surface soil loose.

The soil taken from the holes having been discarded, soil for filling in is obtained by digging the surrounding soil forward. The advantage of this method is threefold: it prevents the walls of the holes being broken, does away with a possible pothole for water, and it ensures that nothing but top soil will come in contact with the roots. If the soil is of a heavy nature the filling-in should be done with a digging-fork.

PRUNING.

During the first three years after planting very little pruning should be done—merely sufficient to keep the tree upright, and to remove water-shoots. A tree should have one main trunk from 18 in. to 2 ft. high. From three to five main branches and as many subsidiary branches will, when provided with laterals, fully furnish the tree without crowding. A total height of about 10 ft. is sufficient. With a tree of this height most of the fruit can be gathered from the ground—a very decided advantage—while pruning and spraying are easily done.

A tree should be built with strong limbs, so that it may carry its crop without undue bending. To effect this the main branches should be shortened occasionally. This shortening will also cause the formation of subsidiary branches; these also should be cut back to promote the growth of laterals, which should bear the major portion of the crop. Extra-strong branches should be kept in subjection by cutting them back as may be necessary. All water-shoots appearing in the centre of the tree should be cut out entirely. The object sought is to form a tree that will be evenly balanced in growth without crowding. A fairly open state of tree fosters fruiting-laterals and facilitates effective spraying. When a tree is allowed to grow more or less in its own way it may produce a fair crop, but much of the fruit will be on the ends of branches, where it is liable to sway with the wind and be rubbed and bruised. Branches may also be broken by the weight of fruit, ruining the tree. Such trees are difficult to spray, and become infested with insect pests and fungus diseases to an otherwise avoidable degree. For these reasons it is desirable to build a strong and fairly open tree, cutting back all straggling shoots and branches, and preserving as nearly as possible an even contour in the whole tree.

RENOVATING OLD TREES.

Trees may become unthrifty from a variety of causes. So long as the roots and trunk are sound it is possible to restore them. Some of the causes of deterioration may be heavy and neglected infestation with insect pests or fungus diseases, or want of systematic pruning. From either of these causes the trees may have a good deal of dead wood, or may have run up in a straggling manner, or have lost branches by breaking down. Such trees should be treated by cutting back all branches to healthy bark, removing all dead wood, and cutting out superfluous branches entirely. Branches removed altogether should be cut hard back to the branch or trunk from which they issue, so as to

leave no snags. Large wounds should be painted over either with Stockholm tar or a thick mixture of white-lead and oil. The tree should then be sprayed with a 1-in-10 solution of lime-sulphur. Cutting down should be done when the trees are more or less dormant—about July. The trees will soon push out numbers of new shoots. These should be thinned to the number required to furnish the tree with new branches, and be afterwards subjected to the same shortening as described in previous paragraphs.

This treatment is advised for trees that have sound roots. Trees that are dying because of roots lost from root-fungus, or roots decayed through stagnant water, obviously cannot be resuscitated, and should be destroyed. It is useless to plant trees in soil that is not thoroughly drained. The soil must be free from surplus water in winter as well as summer. The trees are evergreen, and the roots are never quite dormant. If water lies near the surface for a day or two after heavy rain, even though it may then pass away, such a condition is not suitable. Water should not lie on the ground at all, even during heavy rain. If it does there is sure to be trouble.

TOP-WORKING OLD TREES.

Trees that are in a healthy condition can be reworked with other varieties, either by budding or grafting. The former method is usually adopted, as the result of grafting citrus-trees is somewhat uncertain. Buds may be inserted in the old wood, but working young wood is better and more sure to succeed. The trees should be headed down in the manner previously described, and the new shoots thinned in the same way. Buds may be inserted before midsummer if the wood is large enough, or in early autumn. In the latter case the buds remain dormant till spring. When the buds start the branches are to be headed down to within about 6 in. of the buds. It is not advisable to head close to the bud, as the sap in the wood left above, as described, affords some nourishment to the bud. When the buds make shoots these should be tied to the stumps left, which may save them from being blown off by wind. The stumps of old wood should not be allowed to make any growth. They gradually die down to the bud, and when the bud shoots are strong the stumps should be cut off.

If grafting is decided on, proceed exactly as though the trees were apple-trees. Head the trees down about midwinter, but not entirely. Leave about 1 ft. length to be cut from each branch when the scions are put on. Grafting should be done from mid-August to mid-September. The crown-graft method is best. The trees should be sprayed and wounds painted as advised for trees headed for renovation.

TILLAGE AND MANURING.

For the first few years ploughing should be deep, so as to suppress any roots that grow near the surface. The space around the trees not reached by the plough should be hand-dug, a spade being used so as to sever by a clean cut any roots met with. Later on ploughing will be restricted to the area outside the spread of the trees, the ground beneath the trees being then only surface-cultivated. When this stage of development is reached the trees will be well furnished with roots established in the middle and lower strata of soil. The importance of

a good depth of well-aerated soil cannot be too strongly emphasized, as unless this is provided the roots cannot long remain sound and active, nor can the trees succeed. As before mentioned, trees should not be planted where the proper conditions as described are not present. A thorough system of cultivation should be maintained A loose surface prevents loss of moisture by evaporation in summer, and assists aeration; the roots cannot perform their functions without a certain amount of air.

A considerable amount of humus in the soil is necessary in citrus-culture. During the summer-time weeds should be kept down by cultivation; if allowed to grow they rob the soil of moisture. When autumn rains set in cultivation for the suppression of weeds may not be practicable, nor is it necessary at that time. It may be an advantage to allow them to grow for a few weeks. A carpet of weeds, provided they be not too tall, compacts the surface, and enables the plough to turn a clean furrow. The weeds turned in make humus, and in some cases this may be sufficient. In places, however, where humus is not plentiful in the soil it is necessary to grow cover-crops for ploughing under. Where humus is deficient crops should be grown while the trees are young, and be ploughed in deeply, so as to improve as great a depth of soil as possible. This cannot be done when the roots have taken possession; crops grown after that stage has been reached can only be ploughed under the surface soil, which will be quite sufficient if the earlier work has been well done.

For general use as cover-crops legumes are best; these plants are of a nature that ensures rapid decay, and they add nitrogen to the soil. Lupins, field-peas, and partridge peas are excellent for the purpose, giving a good body of matter that will decompose quickly. These crops are fairly fast growers, but faster still is mustard, which for that reason is often grown, attaining a useful size in about eight weeks from sowing. This plant supplies nothing but humus, therefore a legume is preferable. Mustard is useful when for some reason sowing has been delayed till too late to allow for the development of a leguminous crop. Sowing should be done during the last half of February or early in March.

A green crop should never be ploughed in while the soil is in a dry state, unless it be in late autumn with winter rains soon to follow; late spring or summer are bad times for the purpose. A fair amount of soil-moisture is necessary to ensure the decay of the crop; unless this is present the crop decays very slowly, and until decomposition is far advanced the bulk of material prevents the soil compacting; the soil lies very loose, and not only is there great loss of moisture by evaporation but capillary action is also suspended. Thus the trees almost certainly suffer from drought. Further, it is now recognized that a green crop ploughed into the soil has at first an impoverishing effect. Acid gases generated by decomposition of the green matter render the nitrogen bacteria temporarily inert; they regain activity when decomposition of the green matter is well advanced. This appears to show that green crops should be turned in at the period when the trees are nearest to being dormant, or before that time rather than later. Soil-moisture is usually abundant at that time, and disintegration should be well advanced before the trees reach full activity.

For the first five years vegetable crops may be grown between the rows of trees. It would be necessary to manure for these crops, and they should not be planted so close to the trees as to interfere with the young roots. If these matters are attended to intercropping would probably be beneficial, as the cultivation necessary for the crops would improve the condition of the soil, and should leave it richer than it was before. Potatoes, kumaras, tomatoes, and peas, beans, or other leguminous crops would be suitable.

Lime is always beneficial; besides being in itself a plant-food it improves the condition of the soil, making heavy land looser and light land more compact. It aids the nitrifying bacteria in their work, and liberates potash that may be already in the soil. Authorities on agricultural chemistry state that it is useless to apply potash to soil deficient in lime, which is sufficient to show that lime is indispensable to the nutrition of plants. The amount of lime required cannot in all cases be ascertained except by analysis; if the land is of a proper character 2 tons of carbonate of lime per acre is sufficient. Lime should be applied a few weeks before the trees are planted.

Fertilizers.

If the land is given the attention outlined above the trees will not require fertilizers for a number of years—in fact, not until they produce heavy crops of fruit. The addition of humus and frequent cultivation will have enriched the soil, and the trees should develop well and bear fruit for several years without further feeding. When, however, the trees begin to produce heavy crops fertilizers should be given, as it is bad policy to allow the soil to become impoverished.

The essential requirements are nitrogen, phosphoric acid, and potash. Potash is shown to be abundant in most New Zealand soils, but it is wise to add a small amount of this important fertilizer. It has direct influence on the fruiting-parts of plants, and its presence in the soil should not be left in doubt. One pound of sulphate or muriate of potash is sufficient for a fairly large tree, and should be applied half in spring and the other in autumn. Wood-ashes that have not been weakened by rain are a valuable source of potash, and should not be wasted. Where plenty of such ashes are available no other potash will be needed; about 7 lb. per square rod is an adequate dressing.

Nitrogen is a special requirement of citrus-trees, and although it will be fairly plentiful in a soil treated in the manner described, yet it is not always readily available, and there are times when an additional readily available supply does a great amount of good. For heavy land sulphate of ammonia is best. For all other soils nitrate of soda should be used. Being quick-acting and quickly washed out of the soil by rain, nitrate of soda should be applied only at a time when its aid is immediately required. Only the vegetative part of the tree is affected by this salt. Its use is to promote growth; therefore it should not be given to luxuriant trees, which get all they require without a direct application. Further, nitrate of soda should not be given during autumn or in early spring, because it might be expected to accelerate growth, with a consequent softness which would render the growth liable to frost injury. Apply the nitrate in late spring, allowing 1 lb. for a good-bearing tree.

Phosphoric acid is supplied by superphosphate, which contains no other fertilizer; by bonedust, which may contain also a little nitrogen; and by dried blood, which contains some amount of all the other elements. Blood-and-bone is probably more used in citrus-orchards than any other fertilizer; in this mixture phosphoric acid will predominate, which is as it should be. Although the mixture makes a fairly complete fertilizer, it is not good practice always to use it to the exclusion of others, a change of fertilizer being considered best.

From 4 lb. to 6 lb. of these fertilizers per tree should be allowed. In practice it is considered best to apply it in three dressings—namely, early spring, late spring, and autumn. Nitrate of soda is the only fertilizer that need be applied in late spring. With this eliminated two applications are sufficient—early spring and autumn. The quantity has been stated as per tree; the amount should be calculated on that basis, and distributed over the whole of the ground surface. The fertilizer should not be left on the surface, but harrowed or otherwise scratched in.

(To be continued.)

PHORMIUM TENAX.

THE NEW ZEALAND FIBRE INDUSTRY.

ESMOND H. ATKINSON, Biological Laboratory, Wellington.

IV. MILLING PROCESSES.

THE MAORI METHOD OF EXTRACTION.

In the preparation of phormium-fibre for their many requirements the Maoris were not bound by several conditions that are imposed on the millers of to-day. Economy not being a consideration, they were able to select the very best leaves from the most suitable plants and to reject the rest; they did not need to use any but the most easily stripped portion of the leaf, and the time expended in the actual extraction of the fibre was usually a matter of secondary importance. As a result, the Maori method, though extremely wasteful of raw material, produced a fibre which was very fine and soft and quite free from any deleterious leaf-tissue.

The Maoris avoided as much as possible cutting phormium in the spring and summer when the plant was bearing its flower and fruit, maintaining that the fibre was better in quality and more easily stripped during the autumn and winter months; but in this they may have been unconsciously influenced by the fact that they were busy with their crops, &c., during the other seasons. The fibre-preparation was chiefly carried out by the women and older men.

Clean leaves were selected and only the upper parts used, the leaf being cut off about 6 in. below the point where the two sides of the blade adhere together. The leaf was split along the midrib and the coloured margins and keel rejected. Not only was a considerable amount of

FIG. 1. CUTTER AT WORK IN A PHORMIUM SWAMP.

FIG. 2. ASSEMBLING THE BUNDLES OF LEAF FOR TRANSPORT TO MILL.

Trucks drawn by horses are usually employed on the tramway.

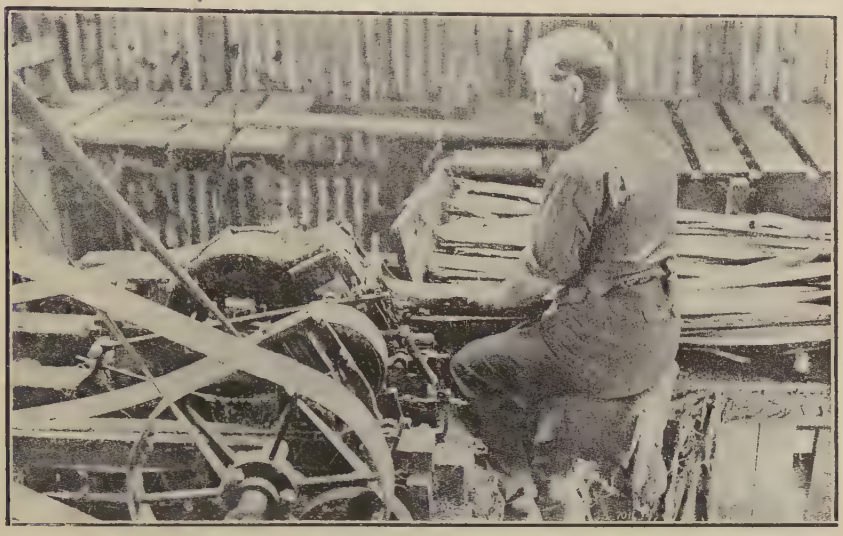


FIG. 3. STRIPPING THE LEAF AT THE MILL.

The leaf is fed into the machine butt end first.

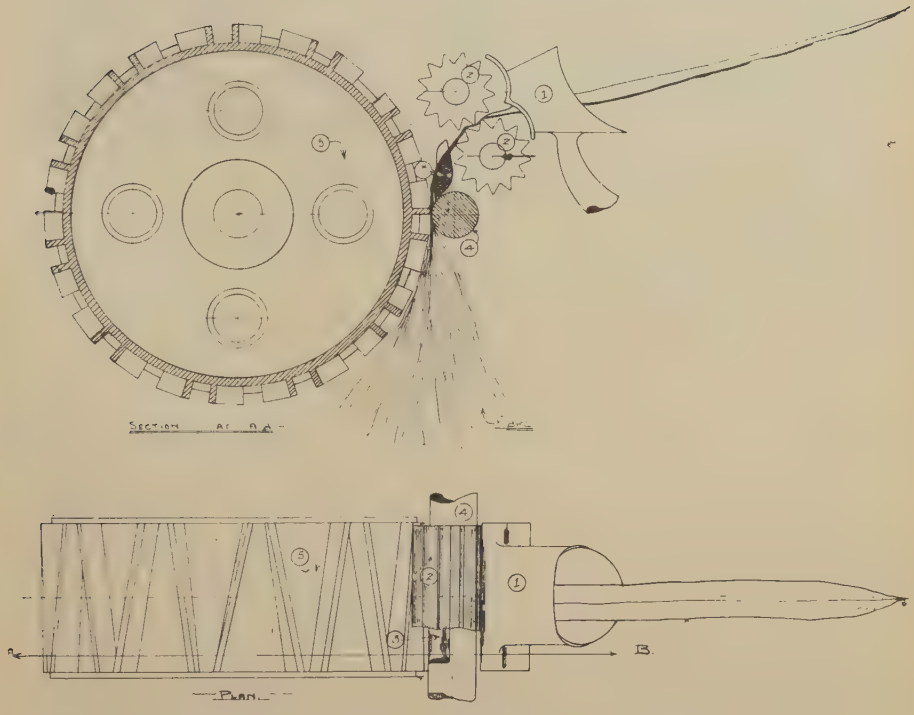


FIG. 4. SECTIONAL VIEW OF A STRIPPER, SHOWING ACTION ON LEAF.

(1) Mouthpiece; (2) feed-rollers; (3) ribber; (4) beater-bar; (5) drum.

available leaf wasted, but a large percentage was lost even of that part selected for stripping, since the fibre on the lower surface of the leaf was not used at all, but removed in the first stage of the process.

The lower surface was cut across with the sharp edge of a mussel-shell, to the depth of about half the thickness of the leaf, which was then placed with the cut downwards on the thigh and pressed against it with the rounded edge of a mussel-shell held just opposite to the cut. On the leaf being now sharply pulled, the whole of the fibres on its upper surface, together with their covering of cuticle, were torn out from the rest of the tissue. The fibre from the lower surface was rejected not on account of its quality, which is as good as that of the upper fibre, but from its being so much surrounded by green tissues as to be difficult to clean. After being stripped the fibre was scraped with the shell to remove as much of the surrounding tissue as possible,

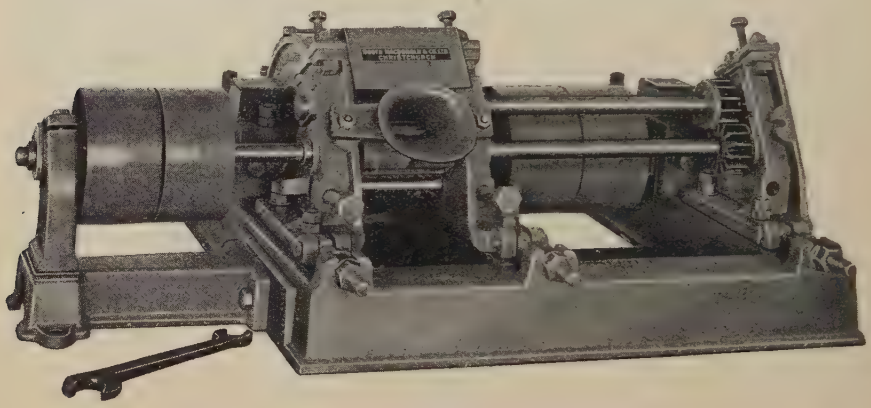


FIG. 5. IMPROVED TYPE OF MODERN STRIPPER.

then thoroughly washed, and again scraped in running water until it was quite clean, then dried, and finally worked and twisted until it became sufficiently soft and pliable for the purposes required.

THE EVOLUTION OF THE PRESENT METHODS.

From the very early days of the industry sporadic attempts had been made to devise some process capable of producing in quantity a fibre comparable in texture and colour to that prepared by the Maoris. The first processes of any real value had for their principle the crushing of the leaves through rollers to extract the fibre, which was then boiled in alkaline solutions and very carefully washed.

The Maori War of 1860 had a very stimulating effect on invention in this field, and a great advance was made in 1861 by Messrs. Purchas and Ninnis, who stripped the leaves by percussion with falling stampers against a solid bed, and in the subsequent part of the process used water only. Although their machine differed considerably in principle from those in use to-day, it marked an important step in the evolution of the present-day type in that it separated the fibre from the surrounding tissue sufficiently well to render the use of chemical solutions unnecessary.

Many different systems of fibre-extraction are described by Hector, in some the entire process being a mechanical one, in others purely chemical; while in others, again, various combinations of these two were made.

The majority of these systems have become obsolete, but the main principle underlying most of the machines invented from 1860 onwards is essentially the same as that on which the present-day type is based, and consists in the stripping of the fibre against a fixed plate by means of projections on a revolving drum (Fig. 4). The chief improvements that have been made relate to the processes following that of stripping—*e.g.*, automatic conveyance and washing of the fibre, and automatic

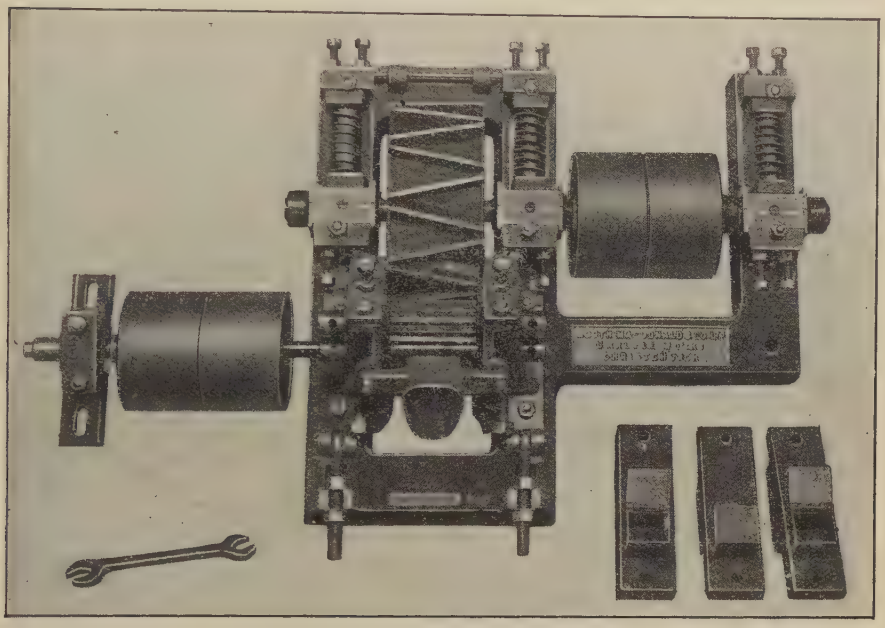


FIG. 6. THE SAME STRIPPER, SHOWING THE SPRINGS (BEHIND THE DRUM-SPINDLE) FOR THE PURPOSE OF EVEN STRIPPING.

Cover of bearings and spring-boxes removed to expose springs to view.

scutching. Prior to the year 1907 these processes were almost universally carried out by hand, but since then the enterprise of inventors, among whom Mr. C. Suttie stands pre-eminent, has reduced the handling of the fibre during the milling to a minimum.

THE PRESENT-DAY MACHINERY AND PROCESS.

Stripping.

The present-day machine for the extraction of the fibre from the green leaf is called a "stripper," and its working principle and construction will be clear from the accompanying illustrations and from the account of the stripping process which follows.

The leaf is cut by hand with a sickle, and is tied in bundles averaging about 90 lb. in weight, which are loaded on to trucks and taken to the mill. In working large swamps light tram-lines are laid —about 3 chains apart —through the area to be cut, being taken up and relaid in a fresh area after the cutting has taken place (Fig. 2).

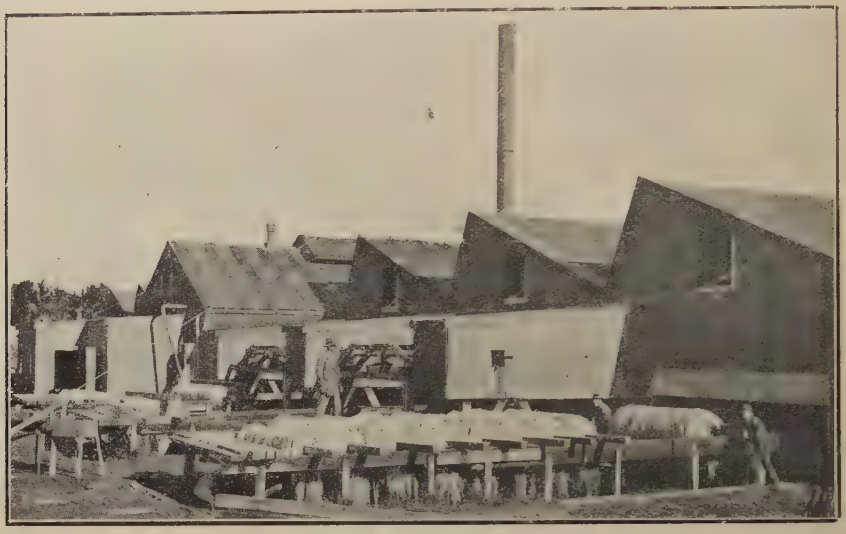


FIG. 7. STRIPPED FIBRE ON DRAINING-POLES OUTSIDE MILL.

FIG. 8. FIBRE IN THE BLEACHING AND DRYING FIELDS.

When the trucks of phormium reach the mill the bundles are weighed (to determine the price to be paid to the contract cutters, as well as to ascertain the proportion of leaf to fibre), and are then stacked in a yard, to be sorted and prepared for stripping. Most millers like to have several days' supply in the yard, partly because of the possibility of wet weather causing delay in cutting, and partly because phormium-leaves feed into the stripper more readily some days after they have been cut.

The leaves—in the best practice—are graded into from two to four qualities—according to the nature of the phormium produced in the particular locality or mill—and are divided up into different lengths, with the object of stripping the varying lengths separately, so that the grades aimed at may be uniform in length as well as in quality.

In the work of stripping, several bundles are placed on a table or bench to the right-hand side of the operator or feeder of the stripping-machine (Fig. 3). The object of the feeder is to feed from two to three leaves into the machine at a time; the expertness of the operator consists in providing an even supply of leaves for the machine, so that the work of stripping may be uniform and effective. The weight of two leaves is about 2 lb. 2 oz., and an average of 24 cwt. an hour is fed by expert operators.

FIG. 9. HANKING DRY FIBRE AND LOADING IN FIELD.

The leaf-blades are gripped by feed-rollers, which feed them at a suitable speed between a fixed bar (the beater-bar) and the stripping-drum. The feed-rollers travel at the rate of about 430 revolutions per minute, while the revolving beating or stripping drum (18 in. in diameter and 6 in. in width) travels at about 2,000 revolutions per minute. The beating-drum consists of a cast-iron cylinder, to the outer surface of which are attached, diagonally and at opposite angles, twenty-two beaters or plates ($\frac{1}{4}$ in. wide and $1\frac{1}{2}$ in. deep), cast upright on the face of the cylinder. In the modern type of stripper the bearings of the drum-axle are fitted with springs, allowing a certain amount of "give" between the drum and the beater-bar, so that the machine automatically adjusts itself to the varying thickness of the leaves that are fed into it (Fig. 6). The drum, travelling against the leaf held in position by the beater-bar and feed-rollers, beats off the bulk of the

"vegetation" (as the green and non-fibrous tissue of the leaf is called), leaving the fibre somewhat deleteriously affected and with a residue of green matter attached.

Washing.

As the fibre leaves the stripper an automatic catching-machine catches it and passes it between washing-drums—two sets of four beaters (covered either with wood or galvanized iron) fixed at equal intervals around and about 2 ft. from a spindle, which work into one another and thereby form, with water continuously flowing over

FIG. 10. SCUTCHING THE FIBRE.

The scutcher—one of the automatic type—is seen on right. On left is a power-press for baling.

them, a fairly effective means of washing away the bulk of the loose vegetable matter. The fibre is carried on an endless chain throughout the washing process, being held meanwhile by an automatic grip, which operates as the fibre is going into the washing-machine and becomes released as the fibre leaves it. Immediately beyond the washer an automatic divider (simply a piece of iron or wood fixed at an angle against the chain) lifts the fibre off the chain, when it is taken by an operative and formed into hanks (each representing the fibre from about fifteen leaves), which are thrown over a pole, so that the water may be drained away (Fig. 7).

In some mills the "stripper-slips"—that is, the refuse composed of short fibres torn out by the stripper and carried away in the washing—

are dredged out of the overflow water by a machine consisting of an endless belt carrying rows of spikes at intervals across it, and constitute a valuable by-product (Fig. 11).

Bleaching.

When fairly dry, generally on the day following, the fibre is taken to paddocks or bleaching-fields to be bleached by exposure to the weather. The hanks are spread to the width of 18 in. in long rows. Here they remain for six or seven days, the time generally required in favourable weather for good bleaching. In the event of the weather not being favourable for drying the fibre while it is lying on the ground, it is hung on wire fences in order to finish the drying process. The fibre when dried is hanked and carted to the scutching-shed (Fig. 9).

FIG. 11. STRIPPER-SLIP-SAVING MACHINE.

It may be mentioned that a sulphur-bleaching process is being experimented with, but is not yet in general use.

Scutching.

The fibre is next scutched, to remove any dry surplus "vegetation." The hand scutcher consists of a skeleton drum of about 5 ft. in diameter and 6 ft. in length, provided with six beaters. It revolves at the rate of about 230 revolutions per minute. This machine is tended by men who feed the fibre into the scutcher in such a way that the hanks hang in front of the drum, thus allowing any loose material and the rough tails to be removed. The short fibres and the dust fall behind the scutching-machine and, after being well shaken to remove the dust and rubbish, constitute what is known commercially as tow.

An automatic scutcher (Fig. 10) is now in use in several of the more advanced types of mills, and has revolutionized this part of the process.

The hanks of fibre are placed over an endless travelling chain, which grips the fibre tightly, carries it through the scutching-drum, and then, after the grip has been changed by an ingenious device to another part of the hank, carries it through the drum a second time, thus allowing that part to be scutched which was held by the chain grip during the first passage of the hank through the drum. As each hank leaves the drum it is automatically released, carried on by the chain, and finally removed by an operative. The tow is blown from the scutcher against a series of rods suspended from the circumference of a circular horizontally revolving table. The rods carry the tow round until a projecting stud is reached, which lifts their free ends and releases the tow, which is then collected into a pile by an automatic fork.

After the fibre has been scutched it is twisted into hanks weighing about 5 lb. each and baled, each bale weighing about 4 cwt. It is then ready for despatch. The whole process from the cutting of the leaf to the baling of the finished product takes from three to six weeks according to the weather.

FIG. 12. PHORMIUM-FIBRE BALED AND LOADED FOR DESPATCH.

On an average 8½ tons of raw material (green leaf) is required to produce 1 ton of fibre proper and 4 cwt. of tow.

WEAKNESS OF PRESENT PROCESS.

The present method of milling phormium is capable of considerable improvement, especially in connection with the extraction of the fibre in an unimpaired condition. The vital part of the process is the stripping, and it is here that improvement is most desired. Up to the present, however, this has not been effected to any great extent, the improvements that have been adopted dealing mainly with the after-processes. The extraction of the fibre from the green leaf-tissue by means of a hard-beating process reduces its strength and produces a large amount of waste material. It would be quite impossible with the machinery at present available to dress out in an uninjured condition the silky fibre of *Phormium Colensoi*.

(Figs. 5 and 6 in this section by courtesy of Messrs. Booth, Macdonald, & Co., Ltd.)

THE PROPAGATION OF FOREST-TREES.

SIMPLE INSTRUCTIONS FOR FARMERS.

H. A. GOUDIE, Conservator, State Forest Service, Rotorua.

THIS article has been prepared with the object of instructing farmers upon the methods necessary to successfully raise a few of the commoner forest-trees from seed. Very often a tree-planting scheme proves disappointing because of the fact that the young trees have to be carried a long distance, and when unpacked it is found that they have heated or have become wilted, owing to lengthy confinement in a packing-case. In skilful hands such trees can very often be nursed back into good health, but to the inexperienced person this is a difficult matter which neither his patience nor time will permit him to try. The advantages to the planter of growing his own trees are many: the trees are handy and can be planted out just when his time permits and the weather is suitable; they are acclimatized, and consequently do not suffer so much in transplanting; and the cost is less.

CHOICE OF LAND.

Any ordinary garden soil will probably prove satisfactory, provided it is clean and deeply tilled. The most suitable soil is a light friable loam. A heavy clay soil should be avoided if possible, because it is difficult to work up to the necessary degree of fineness, and trees grown in it do not produce the fibrous roots that are so essential when they are being transplanted. A deep soil is indispensable, but it need be only moderately rich. Indeed, very rich land is likely to produce large soft-grown trees that will not stand transplanting. The site chosen should be such as will ensure perfect drainage. A hollow where water collects after heavy rain should be avoided. Land with a gentle gradient is best, because, providing the fall does not exceed one in thirty, the surplus rain-water drains away without scouring the seed-bed.

PREPARATION OF THE SOIL AND THE SEED-BED.

Since the best time for sowing tree-seeds is in the spring, land which is to be used for this purpose should be deeply ploughed or dug during the previous autumn. Deep cultivation is essential, and, should the subsoil be close to the surface, hard, or have a tendency to prevent the free drainage of surplus moisture, it will be necessary to trench it.

Tree-seeds may be sown in broad beds, narrow strips, or in drills. It is usual, however, to sow only large seeds, such as oaks or chestnuts, in drills, when the method adopted is simply to stretch a line and distribute the seeds at regular intervals along it and bury them to the desired depth. Most of the small seeds are usually sown in beds or strips, and as the latter method is preferable it is the one that will be here described. The seed-bed should be marked off in a rectangular form to the width and length desired. A width of from 3 ft. to 6 ft. is recommended as being the size most easily worked. Should the land not be level the bed should be laid off to run parallel with the

slope. This will prevent to a great extent the heavy rain from washing away the soil. On each side of the seed-bed a narrow path, about 2 ft. in width, should then be marked off. From this path the soil to a depth of about 4 in. should be removed and spread evenly over the surface of the seed-bed. This raises the level of the seed-bed and assists the drainage of surplus water. The seed-bed should then be worked with a rake until all inequalities on the surface are removed and the surface soil is reduced to a fine tilth. Care must be taken that the soil is properly settled down before the seed-sowing is done, and it is therefore best to prepare the ground some weeks ahead and leave the final raking until the sowing is to take place.

SOWING THE SEED.

To ensure a regular crop the seeds must be evenly distributed and buried to a uniform depth. Seeds sown on an uneven surface will germinate quickly or slowly according to the depth they are placed below the soil, and many of them may get buried too deeply and rot.

A method which is commonly practised and is recommended for sowing small quantities of seed is to obtain a piece of timber slightly longer than the width of the seed-bed, 6 in. or 9 in. in width and 1½ in. or 2 in. thick. This is laid at right angles across the bed, and when walked upon leaves an impression, the surface of which is smooth and even, upon which the seed is sown. In practice, a start is made by laying the plank across the seed-bed 1 ft. or 1 ft. 6 in. away from the end. After an impression sufficiently deep has been made by walking upon the plank it is lifted and replaced about 6 in. farther on and parallel to the first position. The operator again walks upon the plank to form a second impression, and at the same time he sows and covers the seed in the first impression. This process is repeated until the whole of the seed-bed is completed. When sowing pine-seeds the plank is replaced on top of the seeds after they are sown, and then walked upon so as to press all the seeds into the soil to an even depth. Care must be taken when doing this that there is no soil adhering to the plank, or the seeds may be lifted. Sowing is easiest done when the soil is fairly dry, more especially if the land is of a heavy sticky nature when wet. When the plank is placed upon the seed-bed the weight necessary to cause an impression to be made must be applied first about the centre of the bed, and from there to the ends. If the weight is applied first to the ends the seed-bed will slope down at the ends and will not be sufficiently deep in the centre. A little practice will be sufficient to indicate the best method of doing this.

When raking or sowing, a good deal of labour will be saved if the surface of the bed is not walked upon; especially is this the case if the land is of a heavy nature and liable to become solid and hard under the pressure of the feet.

Depth to cover the Seeds.—The covering soil should be put through a ½ in. or ¾ in. sieve, carried in a bucket, and gently scattered over the seed by hand. The depth to which seeds should be covered depends upon the size of the seed and to a certain extent upon the nature of the soil. A loose porous soil should, whenever possible, be used for covering, because then a mistake in covering too deeply is not so serious as when soil of a heavy retentive nature is employed. In free porous soils

most of the pines should have ½ in. of covering soil, in heavy soils slightly less. Small fine seeds, like those of the eucalypts, should be covered and no more. Actually, about ⅛ in. of covering soil is all that is necessary, but in practice this is scarcely possible unless very carefully done by an experienced person and with finely sifted soil.

Quantity of Seed to sow to a Square Yard.—A crop of trees should not exceed from 300 to 500 seedlings to the square yard of seed-bed actually occupied by the crop, and not taking into account the spaces between the beds or drills. As the germinative capacity of the seed varies every year it is possible to give only an approximate idea of the quantity of seed required for a given number of trees without testing the seed. The following table shows the number of fertile seeds usually present in 1 lb. of seed:—

Name of Tree.	Quantity required per Acre for Broadcast Sowing.	Number of Seedlings usually expected from 1 lb. of Seed.
Cupressus Lawsoniana ..	½ lb.	20,000
Cupressus macrocarpa ..	4 lb.	5,000
Pinus radiata	1 lb.	10,000
Pinus muricata	½ lb.	20,000
Pinus ponderosa	2 lb.	4,500
Pseudo-tsuga Douglasii ..	¾ lb.	15,000
Sequoia sempervirens ..	..	1,500*
Eucalyptus amygdalina ..	2 lb.	6,000
Eucalyptus Gunnii ..	6 oz.	30,000
Eucalyptus coriacea ..	4 lb.	3,000
Eucalyptus botryoides ..	6 oz.	30,000
Eucalyptus eugenioides ..	2 lb.	6,000
Eucalyptus fastigata ..	2 lb.	6,000
Eucalyptus gigantea ..	2 lb.	7,000
Eucalyptus Macarthuri ..	6 oz.	30,000
Eucalyptus Muelleriana ..	2 lb.	7,000
Eucalyptus obliqua ..	2 lb.	7,000
Eucalyptus ovata ..	6 oz.	30,000
Eucalyptus pilularis ..	4 lb.	3,000
Eucalyptus regnans ..	2 lb.	6,000
Eucalyptus saligna ..	1 lb.	10,000
Eucalyptus viminalis ..	6 oz.	30,000

* The number is extremely variable.

SHADING AND PROTECTING THE SEED-BEDS.

Except in the very wet parts of the Dominion the heat of the sun dries up the soil too quickly for a good crop of trees to be ensured unless some sort of shading-material is used. For this purpose 10 oz. hessian has been found to act admirably, and although the use of this particular material is not imperative the amount of shade which it affords may be taken as a standard to go by when using other materials. As the depredation of birds and mice has to be guarded against, a wire-netting

frame is usually employed, and this is made to serve the double purpose of protecting the seed and supporting the shading-material. A simple seed-frame can be made by using two lengths of 6 in. by 1½ in. timber on edge and coupling these together with three or four 2 in. by ¾ in. battens, which should be checked in flush with the top. The frame should be made a little under 3 ft. in width, inside measurement, in order to take the standard-sized netting. When the seed has been sown the frame should be placed over the bed and pressed into the ground, so as to ensure it from being easily shifted by the wind or other agency. While scrim is the easiest shading-material to handle, a light covering of manuka scrub serves the purpose very well. When laid on top of the frame it should be made secure by running several thin wires from end to end of the frame, and stretching these tightly before fastening them down. If scrub is laid loosely on top without fastening, it is apt to be blown off by the wind at perhaps a critical time when the seedlings could not endure the full force of the sun's heat.

A method of making seeds distasteful to birds, which is often resorted to, is to coat the seed with red lead. This may be applied mixed either with water or kerosene. With small quantities a simple means of applying the red lead is to place the seed in a bowl, pour in sufficient kerosene or water to moisten all the seeds, and then sprinkle in the red lead, at the same time shaking the bowl so as to cause the seed to roll around the inside. The red lead should be gradually applied until each seed is thoroughly coated.

TENDING SEEDLINGS.

If the sowing is done in the manner described watering will not be necessary unless the weather is exceptionally dry. To be thoroughly effective watering should be done late in the evening, and applied through a fine rose and distributed evenly over every part of the bed. When once watering is resorted to, it must be kept up regularly until a rainfall sufficiently heavy to thoroughly soak the seed-beds is experienced.

The two months following the sowing of the seeds is the period in which the crop will require the closest attention. The beds must be kept scrupulously free of weeds, otherwise a disease known as "damping off" is liable to ruin the crop. This is a fungoid disease which attacks the stem of the seedlings just above the ground-level. At this point the stem becomes slightly dark in colour and soft and pulpy as if rotten, and the weight of the upper part of the stem and leaves causes the plant to fall over. The still, warm, moist atmosphere under a seed-frame is exactly the sort of place in which this disease will flourish, and if weeds are permitted to grow or the crop of seedlings is very thick the disease spreads with greater facility. While it cannot be entirely prevented, it can generally be effectively controlled by keeping the weeds down and by raising the frames sufficiently to permit of a free circulation of air around the young plants. The extra light and the drying influence of the outside air will usually have the desired effect. The writer has observed this disease on seedlings of most of the conifers and eucalypts, and has never known the remedial measures just described to fail if promptly resorted to when the "damping off" first appears.

Removing the Shading.—Having raised the seedlings in a subdued light, care must be taken not to suddenly subject them to the full force of the sun. They must be accustomed gradually to the different atmospheric conditions which will be brought about when the seed-frames and shading have been removed. About two months after the sowing of the seed the frames should be propped up on the side away from the morning sun. This, if the weather be dry, will have the effect of hardening the foliage and stems, particularly of the plants on the side of the bed that is open. In another week the frames may be reversed—that is, propped up on the other side. A fortnight to three weeks is usually sufficient for the hardening-off process, but when the seed-frames are removed from the bed it is always advisable to choose a wet or very dull day for doing so.

TRANSPLANTING SEEDLINGS.

Unless very dry weather has been experienced transplanting can usually be commenced early in April. No arbitrary rule can be laid down, as the amount of moisture in the soil must be the determining factor unless watering is resorted to.

Preparing the Seedlings.—The root of a seedling tree consists generally of a main descending stem or tap-root from which secondary roots and rootlets are given off. The root-system varies in different species, but the form described may for the present be regarded as fairly typical of all species. Some species produce a larger quantity of secondary roots and rootlets than others, but with all species a free, porous, and somewhat sandy soil generally induces the growth of secondary roots, while the reverse is the case with soils of a heavy retentive nature. The quantity of secondary roots, or fibrous roots as they are generally called, has a great influence upon the ability of the young tree to endure transplanting, and it is therefore necessary to adopt such measures as will cause the maximum production of fibrous roots. A method of controlling the growth of the roots of young trees, known as "wrenching," consists in inserting a sharp spade at each side of a row or bed of trees at such an angle as will cause the roots to be severed at from 4 in. to 6 in. below the surface of the ground. The length of the roots is first ascertained by lifting a few plants, and the wrenching is then done so that the length of the roots is reduced by about one-third. With most species of trees wrenching makes a great difference in the quantity of fibrous roots produced.

Some consideration must now be given to the species being dealt with and to the size of the seedlings. Under average conditions it takes two years to produce a tree that is sufficiently large for successful transplanting. Exceptions to this general rule are fast-growing species like the common *Pinus insignis* and most species of eucalypts, which when grown in the warmer parts of the North Island are generally large enough for transplanting about six months from the time of sowing the seed. On the other hand, slower-growing trees may take three years to reach a transplantable size.

When the seedlings have made strong growth wrenching should be done in the autumn—say, in March or April—and in the case of seedlings which are being allowed to remain in the seed-beds or nursery rows for another season again in the spring, about September. It is always

advisable to choose damp weather for wrenching. A period of five to six weeks should elapse between the wrenching and the lifting of the trees for transplanting, as this time is required for the production of the new roots which will have been induced.

Directions for Individual Species.

As it is impossible to lay down cultural directions applicable to the whole of the Dominion, it will be necessary here to deal with the species individually.

Pinus radiata (insignis).—Under favourable conditions the growth made by seedlings of this species is very fast. Seed sown in the month of October will produce plants of from 6 in. to 9 in. in height by the end of March, a period of six months. The soft, sappy stems produced as a result of this rapid growth make the seedlings of this tree much more difficult to handle than might be generally expected with a species that thrives so well in practically all parts of the Dominion. Seedlings should be wrenched as early in the month of March as the weather conditions will permit. As a result of this it will be found that the growth has become firmer and the leaves much harder to the touch. About a month from the time of wrenching the transferring of the seedlings to a permanent position in the plantation must be considered, and if the weather and soil are sufficiently moist no time should be lost in getting them transplanted. Planting done before the end of May will usually give good results. In districts where frosts are frequent it is not profitable to plant out during the months of June and July, so that if the autumn planting is missed it is better to defer it until mid-August or September. If strong seedlings have to be carried over the winter for a spring planting, they should be removed from the seed-beds and lined out in nursery rows in order to check the growth. Failing this frequent wrenchings are necessary.

Seedlings of *Pinus insignis* raised in the colder parts of the North and South Islands usually fail to make sufficient growth to permit of their being planted permanently the first year, and it is therefore necessary to line them out in nursery rows for a year. If the crop in the seed-bed is thin and the seedlings exceptionally small the lining-out may be avoided, provided the plants are frequently wrenched. Actual experience of local conditions is necessary to decide a point of this kind. It should be borne in mind, however, that this species is a particularly strong grower, and if the growth is not checked either by frequent wrenching or lining-out the plants may become too "leggy" to transplant successfully.

Pinus Laricio (Corsican pine), *Pinus ponderosa* (American yellow pine), *Pseudo-tsuga Douglasii* (Douglas fir or Oregon pine), *Larix Europaea* (European larch), *Cupressus Lawsoniana*, and *Cupressus macrocarpa*.—These species, like nearly all of the coniferous trees except the quick-growing *Pinus insignis*, generally require to be carried over in the nursery till the second year before they are of a suitable size for permanent planting. Seeds should be sown during October or November, and, unless the climate, weather, and soil conditions are such as will cause exceptionally strong growth, the seedlings may be safely allowed to remain in the seed-beds for from eighteen to twenty months, provided that wrenching has been properly done.

Eucalypti.—As a class the eucalypts are quick growers, ranking along with *Pinus insignis* in this respect, and for the hardy, good-transplanting kinds the cultural requirements are the same as with that tree. *Eucalyptus globulus, E. viminalis, E. Macarthuri, E. ovata,* and *E. Gunnii* are among the species which, when properly wrenched, produce good fibrous roots, enabling them to be successfully transplanted with open roots, provided reasonable care is exercised to prevent the roots from becoming dry.

Most of the species of eucalypts, however, are not easily transplanted unless each plant has a ball of earth attached to the root when it is being shifted. In dealing with the difficult transplanters it is best to sow the seed in boxes of soil, and prick off the seedlings into small pots or trays when they are about 1 in. high. The pots or trays containing the young plants should then be plunged their full depth in the soil, so that the moisture will be properly conserved during dry weather. After pricking off the plants they should be well soaked with water, and afterwards shaded for a week or more until they have recovered from the shift. If the seed is sown in October the seedlings should be large enough to prick off the following January, and ready for permanent planting in April.

SIZE OF TREES FOR PERMANENT PLANTING.

Under average conditions the best results will be obtained with trees from 6 in. to 12 in. in height having sturdy woody stems and an abundance of fibrous roots. On exposed bare hillsides small plants are best because they suffer less from the wind than large ones, while on land that is covered with a quick-growing noxious weed or bracken large plants are preferable.

Liming Tests in the Wairarapa.—Experiments are being carried out in the Martinborough neighbourhood with Dyerville lime. The deposits are of the shell limestone formation, and are situated about seven miles from Martinborough. Up to the present date experiments carried out by local farmers with this material seem to have given satisfactory results. With a view of making a practical comparison between the respective efficiencies of Dyerville and Mauriceville lime, the Department has planned two co-operative experiments. No. 1 test is to be carried out on Mr. W. A. Iorns's property, and is concerned with the top-dressing of an ordinary pasture paddock with Dyerville and Mauriceville lime; the application of these for comparative purposes is to be in the ratio of 3 : 2. No. 2 test is on Mr. McLeod's property, and will be concerned with the top-dressing of rape; otherwise the experiment will be on similar lines to that at Mr. Iorns's place. Both mechanical and chemical analyses of the Dyerville lime have been made. The percentage of carbonate of lime is 94 to 95—about the same as in Mauriceville limestone. The Dyerville shell material is used uncrushed.—*F. W. Greenwood, Instructor in Agriculture, Wellington.*

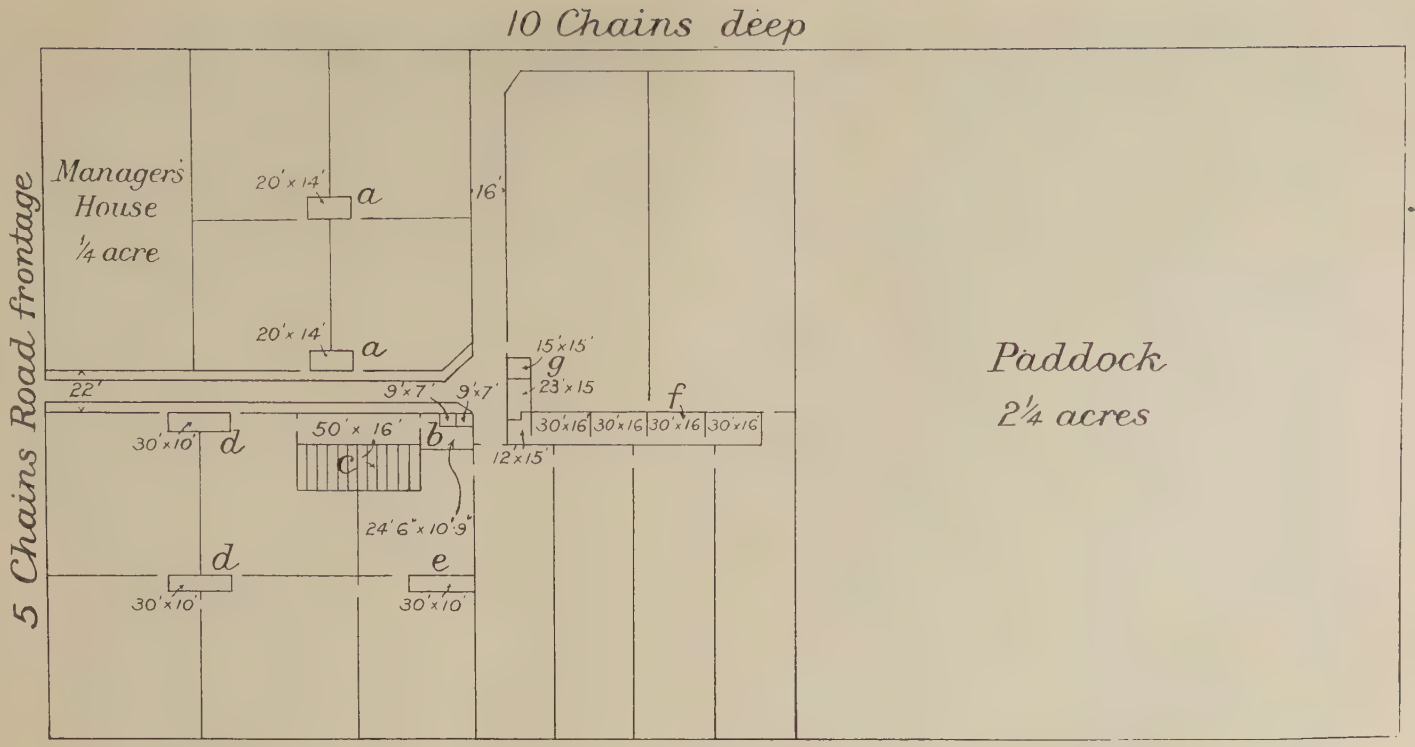
THE AVONHEAD POULTRY PLANT.

F. C. BROWN, Chief Poultry Instructor.

THE Avonhead Training-farm, as indicated by its name, is situated within close reach of the rise of the River Avon, near Christchurch. It was established by the Repatriation Department for the special purpose of training in various branches of rural industry returned soldiers who had a desire to settle on the land. The work of getting the place into order for this purpose, and of training the men, was entrusted to officers of the Department of Agriculture, under the general supervision of the Director of the Live-stock Division, Colonel A. R. Young. The branches of work on which the soldiers receive special training include general agricultural farming (such as the growing of cereals, root crops, &c.), dairying, pig-raising, beekeeping, fruitgrowing, market-gardening, and poultry-keeping.

GENERAL VIEW OF THE AVONHEAD POULTRY PLANT, LOOKING FROM THE FARM HOMESTEAD.

The following notes deal only with the poultry section of the Avonhead establishment. It was not until early in September, 1919, that the place was handed over to the control of the Department of Agriculture, and, this being practically the end of the correct period for hatching out chickens, it might not have been considered feasible to do anything effective in this line during that season on the 5 acres of absolutely bare ground allotted for the poultry plant. However, an old shed on the estate was at once fitted up with fireless brooders, and by purchasing day-old chicks about five hundred young birds were being reared in the course of a few weeks. In addition, during this time some temporary breeding-pens were arranged and stocked with specially selected White Leghorns. Incubators were also procured and located in a motor-shed about a quarter of a mile away from where the rearing operations were being conducted. By this means and from



GROUND-PLAN OF THE AVONHEAD POULTRY PLANT.

(*a*) Breeders; (*b*) incubator-house, with egg-room and office in corner; (*c*) brooder-house and runs; (*d*) pullets; (*e*) cockerels; (*f*) laying-birds; (*g*) feed-room, and room for motor and grinding-mills.

LAYING-HOUSES (ON RIGHT) AND STOREROOMS (ON LEFT).

The general homestead of the training-farm is seen in background.

INTERIOR VIEW OF LAYING-HOUSES.

Showing nest-boxes made from kerosene-tins, and perches fixed on piping.

eggs produced from the special breeding-birds referred to another five hundred chickens were added to the number already on the farm.

Towards the end of the year (1919) the erection of the permanent poultry plant was commenced, and by degrees the young stock were transferred from the rough-and-ready quarters to their permanent home. For those unable to view the plant on the spot the accompanying photographs will give a good idea of its general lay-out and type of buildings adopted. It will be observed that the houses, runs, &c., are arranged in such a manner that the flock can be

BROODER-HOUSE AND OUTSIDE RUNS (NETTED OVER).

INTERIOR OF BROODER-HOUSE, SHOWING SYSTEM OF FIRELESS BROODERS.

attended to in a minimum of time. Not only this, but during unfavourable weather conditions practically all the birds can be tended under cover, and in comfort. This plan should especially appeal to womenfolk, who are frequently entrusted with poultry work, and are too often compelled to go through mud and slush and become wet when attending to the flock.

But while in the Avonhead plan every consideration is given to the comfort of the attendant the desired favourable conditions for the stock are in no way sacrificed. The deep, open-fronted, and well-ventilated houses, together with the large runs attached, provide ideal conditions for fowls, both by day and night, and no matter what the weather may be. It will be observed that the runs are arranged in

BREEDING-PEN OF WHITE LEGHORNS AT THE AVONHEAD PLANT.

such a way that they can be alternately ploughed up, sown down with rape, &c., and allowed to sweeten. The plant is not yet completed. It is proposed this year to install a coke-burning colony brooder, but among other things required are an engine and grinding machinery, and not least a manager's residence.

It may be mentioned that Mr. C. C. Cussen, Poultry Instructor for the South Island, undertook the chief work of supervision in connection with the establishment of the Avonhead plant, and its success is due in a great measure to his efforts. Mr. L. Cocker, Poultry Instructor, also did valuable work in rearing the young stock at the initial stages and under unfavourable conditions; while Mr. S. Willis, at present in charge, is carrying on efficiently. This season's pullets (White Leghorns), numbering 850, are an exceptionally fine lot—large-framed, of good constitution, and laying eggs to match in point of size.

BLACK-SPOT OF THE PEAR AND APPLE.

CONTROL TESTS AT PAPANUI EXPERIMENTAL ORCHARD.

W. K. DALLAS, Orchard Instructor, Christchurch.

A SERIES of experiments in black-spot control was again carried out during the past season at the Papanui Experimental Orchard, Christchurch. The results were very satisfactory, infection having been reduced to a minimum.

The spraying-compounds experimented with were bluestone, bordeaux mixture, lime-sulphur with naphthalene, and Fungol, used in the various schemes and formulas detailed below. A power sprayer was used throughout at a pressure of 150 lb. to 160 lb. Arsenate sprays were applied separately and not within three days of lime-sulphur or other summer spray. Advantage was taken in general of dull days to apply the sprays. The trees were resprayed immediately after rain. In localities where fruit is subject to black-spot this practice should not be neglected.

The varieties upon which the experiments were conducted comprised the pears Winter Nelis, Winter Cole, Bashalier, L'Inconnue, Bishop's Thumb, Beurre Capiaumont, Beurre Clairgeau, Doyenne du Comice, Easter Beurre, Beurre Diel, Vicar of Winkfield, Williams Bon Chrétien, and Glou Morceau; and apple Sturmer Pippin.

TREATMENTS AND RESULTS.

Plot 1.—Bluestone, 1–15, at dormant period; followed by bordeaux, 6–4–50, at open-cluster; and 3–4–40, at fruit-set. Two further applications, at 3–4–50, were applied at intervals of about one month. Varieties: Various pears—62 trees.

Before spraying live black-spot was present on mummified fruit. These mummified fruits were gathered and destroyed. On 16th November the trees were examined, and the fruit and foliage were found to be free from black-spot. The fruit was slightly russeted after the fruit-set application of bordeaux, the Beurre Capiaumont variety being the worst. When examined on 6th January one pear was found slightly affected with spot and it was picked off. On the final examination the fruit and foliage were free from spot. The trees have made good growth. Red mite was prevalent on some trees.

Plot 2.—Bordeaux, 6–4–50, at open-cluster; and 3–4–40, at fruit-set. Two further applications, at 3–4–50, at intervals of about one month. Varieties: Various pears—44 trees.

On 16th November the trees were examined and fruit and foliage found free from spot. The fruit of Winter Nelis was russeted. Glou Morceau was scorched and dropped badly after the fruit-set application of bordeaux. On 6th January three fruits (Winter Nelis) were observed to be slightly affected with spot. These were picked off. On final examination, 7th March, fruit and foliage were free from spot. Trees had made good growth. Glou Morceau was a very light crop.

Plot 3.—Bordeaux, 8–6–40, at bud-movement; 6–4–50, at open-cluster; and 3–4–40, at fruit-set. Two further applications, at 3–4–50, at intervals of about a month. Varieties: Various pears—40 trees.

When examined on 16th November the fruit and foliage were free from spot. The fruit of Winter Nelis showed the effects of a slight scorching after the fruit-set application of bordeaux. On examination on 7th March the fruit and foliage were free from spot. Easter Beurre, a variety very subject to spot in the Canterbury District, was clean. The trees were making good growth. Red mite was prevalent on some of the trees.

Plot 4.—Lime-sulphur with naphthalene, 1 6, at bud-movement; 1–20, at open-cluster; 1–100, at fruit-set. Three further applications, at 1–100, were applied at intervals of about one month. Varieties: Various pears—44 trees.

When examined on 27th October the fruit and foliage were free from spot. On 6th January two pears (Winter Nelis) were showing a slight infection of spot and were picked off. On 3rd February, after several weeks of unseasonable weather, an examination was made and twenty-two infected fruits were found on three trees (Winter Nelis) adjoining one another. These fruits were picked off and destroyed. The remainder of the trees were free from spot. The foliage on the trees was bright and healthy-looking. The trees had made good growth. Red mite nil.

Plot 5.—Fungol (Fungol 1 quart, soap '15 oz., Gargoyle oil 1–25) at bud-movement, and again (Fungol 1–150, soap 1 lb. in 30 gallons, Gargoyle 1–150) at fruit-set. Variety: Sturmer Pippin—5 trees.

When examined on 10th December the fruit and foliage were free from spot. These trees were badly affected with woolly aphis.

SUMMARY AND CONCLUSIONS.

As indicated, the results obtained were most satisfactory. Throughout the season only twenty-eight infected fruits were observed. At the last examination, on 7th March, both fruit and foliage were free from black-spot infection. No better results could be desired. The trees sprayed with bordeaux were all very free from spot, only four infected fruits (Winter Nelis) being found. Bluestone, 1–15, at dormant, followed by bordeaux (bud-movement bordeaux being omitted) showed three infected fruits. Bordeaux, with full number of applications, showed clean trees. Winter Nelis and Beurre Capiaumont were russeted by the fruit-set bordeaux spray. Glou Morceau was russeted and dropped badly, while fruit of a tree of the same variety sprayed with lime-sulphur and naphthalene did not russet and held its fruit. A number of the trees were badly infected with red mite.

A feature of the results obtained in the lime-sulphur with naphthalene plot is that the twenty-four infected fruits (Winter Nelis) were all gathered from three trees adjoining one another, the other trees of the plot being clean. The foliage of the trees in this plot was bright and of a rich green colour. The trees were all free from red mite.

Fungol gave good results, the fruit and foliage of that plot having been maintained free from spot. The fruit-set application slightly russeted the fruits on the under-side. The trees in all plots made good growth

In conclusion, I would like to emphasize the two factors (besides the correct preparation of compounds and their thorough application) which led to such satisfactory results being obtained in this series of experiments: (1) The trees were sprayed to *prevent* infection, spraying not being delayed until black-spot made its appearance; (2) the trees were resprayed in general immediately after rains. The policy for controlling black-spot can be summed up in one word—prevention.

PHOSPHATE IMPORTATIONS FROM OCEAN ISLAND.

THE New Zealand Phosphate Commissioner (Mr. A. F. Ellis) writes pointing out that importations of rock phosphate hitherto shown through the Customs returns as originating from the Gilbert and Ellice Group are really from Ocean Island. The latter is included in the Gilbert and Ellice Colony for administrative purposes, hence the technically correct but misleading statistics. Thus during the year ended 31st March last a total of 8,414 tons of phosphate was imported into New Zealand from Ocean Island. The latter, moreover, might properly be bracketed with Nauru, as being the same business. We understand that in future the Customs returns will be amended on the lines indicated.

ATOMIC SULPHUR: AN EXPLANATION.

IN connection with the recent spraying experiments on the control of powdery mildew, conducted at the Papanui Experimental Orchard, as reported in the April issue of the *Journal* (pages 233–35), several inquiries have been made of officers of the Horticulture Division regarding the apparently poor showing (in plot 4) of atomic sulphur, a fungicide which has in the past given valuable assistance in the control of the disease in question. Mr. W. K. Dallas, Orchard Instructor, who had general charge of the experiments, now writes stating that after investigation he has ascertained that the atomic sulphur used on the occasion referred to was taken from old stock which had been on the premises for some considerable time, and was therefore liable to deterioration, a matter regarding which he had no knowledge when preparing his report. The object of spraying experiments is, of course, to improve the methods of disease-control, not to prejudicially affect the use of any ingredient which up to the present has been satisfactory; hence this explanation.—*Horticulture Division.*

Noxious Weeds.—The Rangitikei County Council has declared foxglove and goat's-rue to be noxious weeds within the meaning of the Noxious Weeds Act in the district under its jurisdiction. Broom has been similarly declared by the local authority as regards the Town of Rotorua.

WORK FOR THE COMING MONTH.

THE ORCHARD.

CABLED reports have recently been received from London, from Mr. G. Stratford (through the High Commissioner), on both the "Hororata" and "Athenic" fruit shipments.

The "Hororata" fruit on the whole arrived in fair condition only. The Dunn's were in excellent order and sold well, but several of the earlier varieties, such as Scarlet and Worcester Pearmains, Gravenstein, and Ribston, varied from moderate to poor condition. This was to some extent expected. These varieties are not good keepers, and, owing to shipping difficulties, they were shipped somewhat late for their season, and the position was made still worse through the boat, after loading, being detained fully three weeks in New Zealand waters before sailing. However, judging from the information so far to hand, the condition of the fruit and the prices realized were fully as good as, or even better than, might have been expected.

On the other hand, the "Athenic" apples are reported to have arrived in excellent condition, and realized prices averaging about 28s. per case. Some of the pears are reported to have arrived in good order, while other varieties appear to have been soft. However, at date of writing sufficient information is not yet available relative to the pears to indicate the true position of the consignment as a whole.

The apparent success of the "Athenic" shipment indicates that when packed and shipped under proper conditions our pip-fruit can be satisfactorily landed on the English market. This assurance together with the fact that more normal shipping-conditions may be looked for in the future, should do much toward inspiring confidence in our export fruit trade. Detailed information on the shipments is expected from Mr. Stratford in due course.

—J. A. Campbell, Assistant Director of the Horticulture Division.

AUCKLAND.

Pruning: All foliage having fallen from deciduous fruit-trees, which in consequence at this period of the year are in their most dormant stage, pruning operations should be carried out in all earnestness. On account of their earlier bud-movement in spring, a commencement should be made with this work upon the stone-fruits, followed immediately by the necessary pruning of pip and citrus trees.

It is necessary here to repeat a warning often given regarding the haphazard manner in which a number of orchardists deal with the season's prunings. There is no doubt whatever that neglect to properly dispose of this wood at the right period is responsible for the spread of a considerable amount of disease in orchards. Growers are warned that, quite apart from danger of infection by other diseases, a very great risk of spreading fireblight-infection is taken by any grower of pip-fruits who fails to attend in detail to the proper disposal of all prunings. A systematic collection of all wood pruned from fruit-trees should be carried out, and the whole should be destroyed by burning. The mere collection of a few of the pieces, and their subsequent disposal by placing them in a shelter-belt or amongst grass where they will escape the eye, will not meet the case.

Grafting and budding: The preparation of pip-fruit stocks for grafting may now be taken in hand. Unsuitable varieties in the orchard should be worked over with good reliable sorts. Stone-fruit trees upon which it is intended to bud during the 1923 summer should now be cut hard back, as in the case of preparing an apple or pear tree for grafting.

Planting: When the soil is in suitable condition planting operations in regard to stone and pip fruits may be proceeded with. With reference to citrus-trees, attention is called to remarks upon this matter in the notes for the month of May.

Fireblight and hawthorn: All growers who would protect their own interests and those of their neighbours must regard *Crataegus* plants generally (including

hawthorn) as a menace to the future of the fruitgrowing industry, and grub out all such plants growing on their properties, and also endeavour to induce all others in the vicinity to do likewise.

Strawberries: All plantings delayed by weather conditions should be completed at the earliest opportunity.

—*J. W. Collard, Orchard Instructor, Auckland.*

HAWKE'S BAY.

The pruning of deciduous fruit-trees will be the main work of this month. When stone-fruit trees have been pruned they should receive an application of lime-sulphur, 1–12, or oil, 1–17, for scale insects, to be followed at the burst of bud by bordeaux, 8–6–40, for fungoid diseases.

Japanese plums often show active bud-movement towards the end of July, and a timely application of bordeaux is very necessary to prevent bladder-plum. No later application can succeed in curing the trouble, so a preventive spray should be applied wherever the disease is known to be present. The above remarks also apply to almond-trees affected with shot-hole.

The pruning of pip-fruits should be completed early, and all refuse cleared away ready for the spring work. Where aphis and scales are present oil, 1–17, may be applied, but the application may with advantage be delayed until the period when trees show distinct bud-movement. This delayed dormant spraying has proved more satisfactory than midwinter applications at stronger proportions.

Where trees are to be grafted they may be lopped down to some little distance above the point where the grafts are to be inserted; this will allow all refuse to be cleared away in good time. A clean fresh cut should be made at the time of grafting.

Planting of all fruit-trees may be carried out where the land is in suitable condition. —*W. H. Rice, Orchard Instructor, Hastings.*

NELSON.

July is essentially the month for orchard pruning, and it is now that this operation is seriously under way. Some experienced growers like to defer it as late as possible, and while much can be said in favour of this practice, in a commercial orchard of any size it is rarely practicable to postpone the commencement of the work later than this month. Growers, more especially those with only a moderate amount of experience, are reminded of the importance of this operation. It is fundamental, and if well considered and thoroughly carried out will make all the work that follows easier and more effective. Some of the important objects of pruning are to ventilate and illumine the fruit-trees, so that every portion remains profitable; also to fill the whole of its sphere with fruit-bearing wood as far as the before-mentioned objects permit. To carry a full crop to maturity a tree has to be structurally strong. A moderate-sized tree has sometimes to carry a swaying load of from 250 lb. to 500 lb., and a further object of proper pruning is to enable it to do this. Furthermore, it is largely within the power of the pruner to direct the vitality of the tree in the way of accelerating or retarding growth at any point. Commence with the stone-fruit trees, as they are the first to break their buds, following on with pears and apples.

Planting may now take place as soon as preparation is completed and the land sufficiently dry. Old trees can be replaced and gaps filled, and hedge and shelter trees planted.

Towards the end of the month some orchards on the lighter lands will be ready for ploughing. A depth of 4 in. or 5 in. is quite enough, and a neat job should be made, turning the weeds or cover-crop well in. When the furrow gets close to bearing-trees use an orchard plough to get close in to the trunks. Harrow soon after ploughing—first *with* the furrows, then angleways or across, to fill up the empty furrows, and leave the whole surface covered with a soil mulch.

Give the fruit-store careful supervision, and keep well in touch with developments taking place there. —*W. C. Hyde, Orchard Instructor, Nelson.*

NELSON CENTRAL.

In the latter part of May heavy rain fell, prior to which a long spell of favourable weather had been experienced. Where orchards are kept in good tilth a certain amount of scouring takes place and silt is deposited in the lower

parts of the orchard, often covering the trunks of the trees up to the framework. If allowed to remain this often causes the loss of some of the best trees. The time taken in remedying this is well spent.

During pruning-time close observation of each individual tree is an easy matter. Diseases such as San Jose scale often escape notice during the growing-period, but when the tree is bare the dark scurfy appearance cannot fail to attract attention. Do not treat this disease lightly; deal drastically with isolated cases while eradication is still an easy matter. Prune away badly affected shoots and branches, and spray or paint over with strong solutions of spraying-oil during the dormant period.

Another disease, generally called "Delicious canker," should receive more attention to prevent its spread. Affected parts should be painted over with bordeaux paste, obtained by dissolving 1 lb. bluestone in 1 gallon water, also 1 lb. lime or 2 lb. washing-soda in 1 gallon water, and mixing both solutions as for bordeaux. Let the mixture stand till settling takes place; then pour off the clear water, which will leave a thickish solution to apply to the diseased areas. This mixture is also useful for painting over large cuts, to prevent silver-blight and other fungus diseases gaining entrance.

Growers should also decide at this time what trees require grafting over. There are quite a number of instances where the variety originally planted has proved unsuitable for its position in the orchard, and a more vigorous variety can be substituted by grafting in the spring. Trees for reworking can be left unpruned till the time for grafting comes along, taking care to put aside good, clean, fairly vigorous scions in a damp and shady situation in readiness for the work.

The question of shelter requires more consideration in this district. A belt of shelter-trees following the main ridges, or round the headlands where suitable, will be of more value to the orchard than the fruit-trees sacrificed to make room for them, and the benefit to be derived can be plainly seen in those orchards where the need for shelter was realized earlier in the development of the orchard lands.

Fruit in both cool-store and ordinary fruit-houses needs watching closely for signs of deterioration, bitter-pit, &c. Do not ship early-packed fruit without repacking, except after very close inspection through several cases. My experience in the fruit-auction rooms during the last two seasons, in Dunedin, has convinced me that in many instances some fruits in the case had already started to go wrong before it left the grower's or dealer's hands. In other instances rough handling during repacking has been the cause of deterioration. Stored fruit will not stand the handling that fresh-picked fruit will without injury.

—*J. H. Thorp, Orchard Instructor, Mapua.*

MOTUEKA.

Pruning and winter ploughing will be the main work occupying the attention of the orchardist during the coming month. In this direction the lines recommended in last month's notes should be borne in mind.

Where new planting is contemplated the ground should be got ready, and planting may be commenced as soon as the weather is favourable. Trees received for planting should be kept heeled in until required.

Stored fruit should be closely watched, and marketed as the condition of the fruit and the market price warrant.

The spray-pump and outfit should be overhauled, and necessary repairs, &c., carried out before the busy spraying season commences. Some growers are neglectful of this until the time comes to spray, with the result that some very important sprayings are delayed considerably.

—*W. T. Goodwin, Orchard Instructor, Motueka.*

CANTERBURY.

Pruning: The most important work during July is pruning, which in large orchards must be pushed on as fast as possible, so that it will be completed before the trees break into growth in the spring. A fact which must be kept in mind is that every tree has its own individuality, and a careful study should be made of the habits, fruitfulness, general development, and age of the different trees. As the primary object of pruning is for profit, unnecessarily hard cutting-back, which would induce excessive growth, must be avoided. Strong-growing trees

should be pruned lightly to maintain the shape, and the weak-growing ones heavily to promote wood-growth. It must not, of course, be expected that pruning will overcome weakness in trees caused by unsuitable soil conditions and disease. Growers who are not acquainted with the principles and objects of pruning should get in touch with the Orchard Instructor for the district and obtain instruction. All prunings should be gathered and burnt as soon as possible. While working around the trees always keep a sharp lookout for disease, and note affected trees. Weak trees should be marked so that special treatment may be given in the spring.

Maintenance of Plant: During the winter months advantage should be taken of the rainy days to clean, oil, repair, or paint harness, tools, and implements, &c. The spray-pump should be first to receive attention, and the whole outfit put in good working-order.

Cultivation: Ploughing should be completed as early as possible. At the Rothamsted Experimental Station it has been found that land ploughed in the autumn benefits more than that ploughed after midwinter.

Cover-crops: Green-manure crops which have attained sufficient height should be ploughed under, so that the material may rot and the nutriment which it contains become available to the trees when they require it.

Marketing: The remarks in last month's notes still apply.

Fruitgrowers' Instructional Classes: All fruitgrowers and other interested persons are invited to become members of the classes which are held in Baker's Buildings, Manchester Street, Christchurch, on Monday evenings at 7.30 p.m. sharp. Upon application a syllabus of the lectures to be given may be had from the Orchard Instructor. —*W. K. Dallas, Orchard Instructor, Christchurch.*

POULTRY-KEEPING.

F. C. BROWN, Chief Poultry Instructor.

MATING THE BREEDING-STOCK.

JULY should see the heavier breeds of birds, such as Orpingtons, Wyandottes, and Rocks, mated up, and their eggs being put down for incubation. If the chickens are to develop into really profitable stock they must be hatched out not later than the end of August. Therefore there should be no delay in getting the desired number of young stock hatched from these dual-purpose breeds. The hatching of the lighter breeds, such as Leghorns, Minorcas, &c., may be delayed until September or even October, but not later. However, in order that the birds may become well settled down before eggs are required for incubation, they should be mated at once.

It should be ever remembered that in the work of hatching chickens it is always better to be on the early side rather than the late. Indeed, if the most money is to be made from poultry-keeping, there must be no such thing as late-hatched stock on the place. No other chickens do so well as those which make their main development before the hot summer days set in. I realize that it is not possible for every poultry-keeper to hatch out his chickens very early in the season unless pullets are bred from, and this latter course is not recommended if it can possibly be avoided. The subject is a difficult one, for, especially in the South Island, it is seldom that many adult birds in a flock will lay early enough for incubation work to be carried out in July or August. The use of pullets is not so much objected to, providing they are carefully selected, have commenced to lay without being forced early in the year, and have moulted at the usual time—that is, with the adult birds about April or May. They should also be mated with a male bird in its second year in preference to a cockerel. When early-hatched, well-matured pullets are not at hand it will always be found a wise course to delay hatching till the eggs of the mature birds are available.

In mating stock the first essential is to see that no bird of either sex is placed in the breeding-pen unless it possesses the desired vigour. Those who are not familiar with the correct type of bird to breed from should study the plates and

particulars of the various breeds contained in the new Utility-poultry Standards, copies of which may be obtained from the Department of Agriculture at a cost of 3s. each, postage free.

Cocks fighting.—Very often when two cockerels are used in the one breeding-pen they are apt to fight for supremacy, and seriously injure themselves from a breeding viewpoint. This trouble may be minimized by adopting the following treatment: Let the birds fight for a few minutes; then pick up the bird which appears to be the weakest and getting the worst of it; put his head under his wing; hold him firmly with one hand on each side and turn him round and round a few times; and then place him on the ground just in front of his opponent. The latter soon knocks over the giddy bird, which, not being clear as to what happened, feels that he has been fairly beaten and usually gives up fighting with the other bird. Sometimes the treatment has to be repeated once or twice before the desired end is achieved.

COLDS AND THEIR TREATMENT.

Of late I have received many complaints in regard to pullets contracting colds. In some cases, judging by the symptoms described, the colds have been well developed—in fact, bordering on roup. Unfortunately, the majority of correspondents who desire information regarding this and other troubles affecting their poultry briefly describe only some of the most pronounced symptoms, and ask for the best means of effecting a cure. Seldom or never do they give any information in regard to the conditions under which the birds are being kept. They quite fail to realize that there must be a cause of the trouble, and that it is next to useless trying to cure it if the cause is not first removed. In all cases of disease affecting poultry the first essential is to endeavour to find the cause, and remove it. Therefore those who are in search of information regarding troubles in their flock cannot be too explicit in giving full details as to the symptoms shown, the food supplied, the style of house, the system of ventilation provided, the age of the birds, and whether they have a free range or are under confined conditions. Without these particulars it is difficult, or indeed impossible, to arrive with any degree of certainty at the probable cause of the trouble, much less advise as to its prevention.

Colds are usually brought about by exposed conditions, while ill-ventilated, overcrowded, and dirty quarters are often responsible. Under the latter conditions the bird becomes overheated by night, which makes it susceptible to chill immediately it goes out-of-doors. Another common cause of colds is compelling a bird to sleep in a draught. Some people adopt the open-front lean-to house as a means of admitting a maximum amount of fresh air and sunlight, but where they make the mistake is in having cracks in the sides and back walls. This means that a current of air is created and the bird is compelled to sleep in a draught. It cannot be emphasized too strongly that the modern lean-to house with open or partly open front must be draught-proof—that is to say, the sides and back walls must be free from cracks. Even one small crack close to where a bird is roosting may cause no end of trouble. This may give only one bird a cold, but if not checked at once the whole flock may soon become affected. Particularly may this occur through the drinking-water.

Colds may be prevented from spreading by putting some Condy's Fluid in the drinking-water. Dissolve a teaspoonful of Condy's crystals into a pint bottle of water. Add one dessert-spoonful of this fluid to about two quarts of drinking-water three times a week, and on such days give the birds no other water to drink. For well-developed colds dip the bird's beak into pure kerosene sufficiently deep to cover the nostrils, and hold the bird in this position until it breathes, repeating the treatment on alternate days. This will usually effect a cure, but, as before mentioned, if the cause is not found and removed the trouble is likely to recur.

The most pronounced symptoms of colds are deep breathing, sneezing, eyes watering, and nostrils running. The latter is responsible for the dry mucus found adhering to the feathers under the wing of an affected bird. The fact of the bird sleeping with its head under its wing causes the discharge to collect nightly until it becomes an unsightly mass. When colds have developed into roup the breath becomes offensive, and finally a cheese-like substance protrudes from the eyes. When this stage has been reached little or nothing can be done for the bird, and usually the best course is to kill it and burn the carcase.

THE APIARY.

G. V. WESTBROOKE, Apiary Instructor.

As advised last month, there should be no occasion to open the hives at this time of the year. During the cold weather the bees will be closely clustered to conserve the warmth, and therefore it is not advisable to disturb this cluster.

In cases where there is any doubt as to whether there are sufficient stores in the hives, a block of candy may be placed on the top of the centre frames—disturbing the bees as little as possible. In warmer localities the candy may be placed on the top of the mat, turning back one corner to allow the bees access to it. In making candy for winter feeding, take 40 lb. of cane-sugar and 10 lb. of honey (free from disease); place these in a preserving-pan, add 4 pints of water, place over a slow fire, and stir until all is dissolved; then boil briskly until the mixture will harden on a stick dipped in it and placed in cold water. When it reaches this stage remove it from the stove and place the pan in a cold-water bath, stirring the candy vigorously until it becomes too stiff to stir any longer. It may then be poured into moulds of suitable size, first lining them with greased paper. Half-section frames containing four empty sections make a good receptacle for the candy, as they can be placed in a half-super over the hive when required.

Now is the time to send away beeswax to be made up into foundation comb. It is always good policy to obtain one's foundation well ahead, and not leave the procuring of it until the spring. This also applies to all materials required for the coming season. Do not wait until the bees are ready to swarm before making up hives and frames. Those who are in doubt as to the best methods to adopt in making up the necessary frames, hives, &c., are advised to send for the Department's bulletin on bee-culture (No. 55), which will afford the beginner very useful information.

VITICULTURE.

J. C. WOODFIN, Vine and Wine Instructor.

THE VINEHOUSE.

PRUNING and general cleaning-up, as advised in last month's notes, can be continued through the coming month, burning all the trimmings and leaves from the vines to destroy fungus, insects, or eggs which may be present, and storing the resulting ashes in a dry place for later application to the soil.

The state of the drainage of the borders should be ascertained, and repairs or alterations made where judged necessary for assuring the effective dispersal of the superfluous moisture to be expected from the winter rains. A well-drained border is an indispensable condition to the health and fruitfulness of the vines. The spouting and gutters should also be attended to. A leak near the roots of a vine has a very injurious effect, frequently rotting them. One of the first visible signs of this is a want of colour, the leaves having a yellowish appearance, easily distinguished among the green leaves of the neighbouring vines.

Another discoloration of the vine-leaf, frequently noticed in the vinehouse, is a reddish tinge starting early in the season and gradually deepening to a bright metallic red. This is frequently due to an overdose of liquid manure through the proximity of a dung-heap, or the roots having found their way into a sewage-drain or cesspool. Burying dead animals in the border will also produce this effect. This practice, which seems to have been handed down from traditional sources by amateur growers, has generally contrary results to those looked for. The putrefying flesh, instead of strengthening the vines, considerably reduces their vitality. Vines amply repay the application of suitable manure in reasonable quantities, but manuring in excess—that is, more than the vine can utilize profitably—when not actually harmful represents a loss, as it will be carried away in the drainage.

CELLAR AND VINEYARD.

Continue the racking of new wines and keep the casks filled.

When casks have been treated with a solution of soda-crystals or caustic soda to clean them, they should be rinsed out with several waters, then filled to the bung, and the water allowed to remain for a couple of days so as to take up all the soda, which would otherwise give an objectionable taste to the wine. Crude

potash, or, if this is not obtainable, carbonate of potash, is preferable to soda for cleaning casks and vats. The reason for this is that potash is one of the constituents of grape-juice and also of wood, and any trace of it remaining in the cask has no effect on the wine beyond neutralizing a little acidity. The crude potash is simply mixed with sufficient hot water to make a solution strong enough to float an egg, but the carbonate, to render it caustic, must be mixed in water with half its weight of quicklime, allowed to settle, poured off the lime, and then used at proper strength and heat.

Pruning can now be commenced in the smaller vineyards outside the frosty areas, but in the latter localities the vines should be pruned later, as near as possible to the time the buds begin to swell. In districts where late frosts are to be feared a partial pruning can be performed, if considered necessary, for facilitating cultivation, leaving about 1 ft. of wood above the last bud needed, and removing it later. This procedure is employed in the Médoc district of France.

THE GARDEN.

W. H. TAYLOR, Horticulturist.

MANURING FOR VEGETABLE-CULTURE.

THE time for general sowing and planting being near, a few remarks on fertilizers should be of use. Most commonly amateur cultivators are content to make use of one fertilizer. A question frequently asked is, "Which is the best for vegetables—superphosphate, basic slag, bonedust, blood-and-bone, or blood manure?" The answer is that any of them may be best and any may be insufficient.

It is farming practice that is largely responsible for the supposition that one fertilizer is sufficient. Farming practice is, however, quite different from garden practice. On a farm crops are usually grown in a system of rotation. Grassland when broken up is fairly well supplied with plant-food—supposing, of course, it is fairly good land. When a crop is sown a little fertilizer is drilled in just under the seeds. This is to give the seedlings a good start. Superphosphate is most frequently used, as it encourages the formation of roots. The young plant being well stocked with roots, these reach out into the surrounding soil and find what the plant requires. After several years' cropping the land is again laid down in grass. Cattle graze on the grass, returning in their dung a large part of the plants they eat, so that the soil is not very much impoverished by their grazing. There is a loss represented by the bone, flesh, wool, or milk taken away, but this is largely compensated for by the changed form of the grass eaten represented by the dung, by the effect of the atmosphere on the rested soil, and by the eventual turning-in of the grass-sod. In the meantime the land has probably been top-dressed with some phosphatic fertilizer, and perhaps with lime. Such land when again broken up is able to produce crops with the same minimum amount of fertilizer as when first cropped; possibly it may grow better crops.

Garden practice is quite different in that the ground is cropped continuously. Therefore if crops are expected to be satisfactory complete manures should be used. The chief requirements of plants are lime, phosphoric acid, potash, and nitrogen; these are known as "the big four." Humus is an absolute necessity. Soil may be well supplied with the chief constituents required for plant-growth, yet if humus is wanting it may be almost sterile. Stable or farmyard manure is by far the best fertilizer for use in vegetable-gardens; it has a value far greater than is shown by analysis. This is due to its humus contents being in exactly the right condition. Given a sufficiency of this material and proper liming, no artificials are really necessary, although extra-good results may be secured by a judicious use of some of them, particularly nitrate of soda, which has the effect of giving a quick start to young plants. The writer of this article cultivated vegetable, fruit, and flower gardens for many years and never used any artificial fertilizer except nitrate of soda.

Root crops, such as carrots, parsnips, and beet, should not be grown on freshly manured ground, because it causes the roots to make side hair-roots, and the vegetables are coarse and rank in flavour. The best place to grow them is on a plot that was well manured the previous year for some other crop. No fertilizer will be required.

Cow-manure is suitable for use in light or sandy soil, but should not be applied to ordinary loam soils, as it makes such soil heavy and difficult to work. Sheep-manure is bad for heavy soil, excellent for light soil, but fills a place full of weeds. For this reason its use is not advocated, though it is better than artificials. Fowl-manure is nearly complete if properly saved. It should be gathered frequently and stored in a dry place, mixed with equal parts of dry earth. Lime should not be added to it, as it drives off ammonia and robs it of its most valuable constituent; nor should wood-ashes be mixed with it, as they contain a large amount of lime. Wood-ashes are a more or less valuable source of potash; they are valuable to all crops if properly saved, and kept dry till used. Soot from coal-fires is a powerful fertilizer and is complete. The best crops of peas I have grown have been when soot was strewn on the peas in the drill before covering them with soil.

When artificial fertilizers are used superphosphate and sulphate of potash are sufficient for root crops. All other crops should have a complete fertilizer, either made up or by using one of the most complete. It is not good practice to continually use the same mixture. Lime, though necessary in any system of manuring, is especially so when artificial fertilizers are extensively used. Needing lime the soil quickly becomes sour, and also a good deal of the fertilizer lies idle in the soil.

Nitrogenous fertilizers affect only the vegetative part of a plant—that is to say, they encourage green growth. Properly used they are very valuable. An amount much in excess of requirements makes growth too soft and renders the plants liable to disease. Nitrate of soda and sulphate of ammonia are two important nitrogenous fertilizers. These two fertilizers differ in one respect. The nitrate is quick-acting, being easily soluble in water. For this reason it is of use where a quick forcing fertilizer is required It should be applied only to growing plants, as it is quickly washed out of the soil by rain. Sulphate of ammonia is slow in action, which means that it has to undergo changes in the soil, and it is not readily soluble. It is valuable for potatoes and tomatoes, and for other crops where a sudden forcing effect is not desirable.

Small Birds: One Side of the Problem.—The official *Agricultural Gazette of Canada* makes the following editorial comment: "The economic value of birds to agriculture, both as regards insects and weeds, is not sufficiently realized. As the natural guardians against destructive insects they are the farmer's chief ally. Their extermination would soon see mankind at the mercy of the insect world, and they should be protected by every possible means. The instinct to kill the wild things, so persistent in youth, is a survival from primitive man which should be controlled by instruction and enlightenment. The study of bird-life in the schools and the formation of bird clubs, both for young people and adults, should accomplish very useful results in this connection."

REPATRIATION QUARTERS AT THE CENTRAL DEVELOPMENT FARM, WERAROA.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

DOG WITH FITS.

S. F. LOGAN, Pakotai :—

I should be glad of advice as to treatment of a young bitch which takes fits. The spasms commence with severe shaking of the head; she then falls, and the whole body is convulsed, foam appearing at the mouth. She appears to recover on regaining her feet.

The Live-stock Division :—

Apparently the animal is suffering from tapeworm. It should be given 1 dram of areca-nut and 20 drops of extract of male fern, made into a pill and given on an empty stomach. This quantity is sufficient for a medium-sized dog.

SPENT TAN-BARK FOR GARDEN USE.

H. W. BRODERICK, New Lynn :—

Please inform me if rotted spent tan-material is a good manure for gardens? Several people here use it and appear to get good results.

The Horticulture Division :—

Tanners' spent bark, when reduced to mould, is useful for soil deficient in humus. Being very light it should be used sparingly, except in fairly heavy soil. It would be useful for a sandy soil where there is a fair amount of moisture. Plants growing in spent tan make a great number of fibrous roots, it having in this respect an effect similar to that of good leaf-mould. Beds of tan in a semi-shaded position, such as in a bush-house, are excellent for striking cuttings of most hardy plants and shrubs, particularly at out-of-season times.

POTATO-HAULMS AND POTATOES AS FOOD FOR DAIRY COWS.

IVAN PENROSE, Wendon Valley :—

I find my dairy cows very fond of potato-haulms and the raw tubers. Are either injurious to cattle in the raw state, and has the potato any value as a milk-producing food?

The Live-stock Division :—

The haulms of potatoes are not by any means an ideal feeding-stuff. Where cattle have an option they are seldom touched, although there are cases on record where cows have broken into a garden and devoured the green potato-haulms with fatal results. The chief feeding constituent of potatoes is starch; protein and fat are in very small quantities. A poisonous material called solanine is always present, the tubers containing about 1½ grains in every 2½ lb. A much larger amount is present in the haulms, and in the young sprouts the proportion may rise to 700 grains to every 2½ lb. This means that the young sprouts of germinating tubers should on no account be used, and that the green haulms if eaten in quantity are dangerous. Raw potatoes, if used, should be sliced and added gradually to the daily ration; also, when they have to be discontinued

this should be done by degrees. It is not desirable to feed in large quantities or for too long. It is believed by many that raw potatoes cause colic, tympanites, lameness, and abortion in pregnant cattle, and there is no doubt that some of these disturbances appear if long or heavy feeding is persisted in.

MAKING BASIC SUPERPHOSPHATE.

"SUBSCRIBER," Whangarata :—

What are the correct proportions in which lime and superphosphate should be mixed to make basic superphosphate? Will carbonate of lime do for this purpose?

The Fields Instruction Branch :—

We advise for preference the use of burnt or quick lime for this purpose, mixing about 15 per cent. of it with the superphosphate. It can be mixed on a clean concrete or boarded floor, the former for preference. Chemical action will take place, and the material will be ready for use with perfect safety the day after mixing. If carbonate of lime is used (and theoretically about double the amount should be added as compared with quicklime), you will have a lime-super mixture that will slowly revert the superphosphate.

APPLE-TREE STOCKS.

"AMATEUR," Palmerston North :—

Will you kindly tell me if any harm will result from planting apple-trees with the graft slightly under the ground.

The Horticulture Division :—

Fruit-trees are worked on to stocks so as to ensure that the roots be of the right description. In the case of the apple the Northern Spy is generally used as a stock. This variety has a good rooting habit and is immune to attacks of woolly aphis. Trees are worked high so as to secure a length of Northern Spy wood clear above the soil-surface. If the point of union is below the surface the immune trunk is lost, and roots would be likely to spring from the base of the scion. In such cases the stock-roots would die out and the tree would be on its own roots. Unless the variety is immune to woolly aphis the roots would become infested by the pest, and the tree would probably fail. The dead roots of the stock would be likely to cause trouble by breeding fungus. In view of the probable danger it would be wiser to plant a young tree in its stead.

FLOOR-SPACE IN FOWLHOUSES.

A. S., Feilding :

Will you kindly inform me what floor-space should be allowed for each bird in a fowlhouse, and what area each bird should be allowed in the outside yards or runs—provided, of course, that the buildings are of the required height?

The Chief Poultry Instructor :—

As a general rule nothing less than 3 square feet of floor-space should be allowed each fowl. Birds confined to the house entirely should have 4 square feet per bird. As to run accommodation, 130 square feet per bird would prove sufficient, but in general where large flocks of fowls are kept the bigger the run the better will be the results.

SEED-POTATOES AFFECTED WITH SCAB.

"SUBSCRIBER," Morrinsville :—

Could one plant seed-potatoes slightly affected with "rust" and yet obtain satisfactory results?

The Horticulture Division :—

It is presumed the term "rust" which you use refers to potato-scab (*Oospora scabies*). This disease does not affect the growing and cropping powers of the sets, but if you plant diseased sets you must be prepared to lift a diseased crop, unless you disinfect the seed-tubers. This can be done by immersing the tubers in a solution consisting of 1 pint of formalin in 30 gallons of water. Leave the tubers two hours in the solution and then spread them out to dry before planting.

WINTER FEEDING OF IN-CALF COWS.

E. L. S., Oreore :—

Will you please inform me if the turning of cows and heifers in calf upon turnips through the winter would have a bad effect on the animals? As I have no hay I must feed them on turnips for a while, but could give them a run off on to grass once a day.

The Live-stock Division :—

We are afraid you will only meet trouble if you feed your stock in the way you suggest. Ninety per cent. of the turnip is water, and there must be some bulk in a food before the animal is able to deal with it in a proper manner. If hay is not available the turnips should be supplemented, if possible, with some straw or oaten chaff; otherwise, apart from the digestive disturbances that will follow, your cows will be running a big risk of contracting redwater later on.

CROPS FOR PIG-FEEDING.

"Far North," Awanui :—

What are the best crops to grow for pigs—mainly for winter feed? When should these crops be sown, and when fed off? I am anxious to give artichokes a trial.

The Instructor in Swine Husbandry :—

Turnips, carrots, mangolds, pumpkins, oats and peas, barley and vetches, and artichokes are all suitable. The first-mentioned crops are sown in spring or early summer, and the cereal and legume crops in the autumn, while artichokes can be planted about the same time as potatoes. Artichokes will in the future prove to be one of the best winter feeds for pigs, especially for brood-sows and good strong stores. The pigs will, if allowed, harvest all these crops with the exception of mangolds, which must be pulled and stored or pitted before feeding, otherwise there is a danger from scouring. A system of small paddocks will be the best, one for each crop, the pigs to be moved about from paddock to paddock weekly so as to give them plenty of change, which helps them to consume more of the feeds and thus put on more daily gain in flesh.

Direct Trade with South America.—The Shaw, Savill, and Albion Company have arranged for the s.s. "Arawa," sailing for London from Wellington about 16th July, to call at Montevideo. Inquiries by New Zealand shippers regarding freight to that port should be addressed to the company's agents at the nearest port.

Importation of Apples and Pears from New Zealand into Hawaii.—The following extract from a rule made by the Board of Commissioners of Agriculture and Forestry of the Territory of Hawaii, permitting the introduction of fresh apples and pears from New Zealand, is published for general information: "Fresh apples and pears may be imported into the Territory of Hawaii direct from New Zealand in cold storage only if they are free from insect pests and plant-diseases and are accompanied by a Government certificate declaring that the apples and pears have been grown in New Zealand and are shipped free from insect pests and plant-diseases, and are also accompanied by a Government certificate declaring that they have not and will not come in contact with Australian-grown fruit on the voyage to the Territory of Hawaii."

MOULDS ON COLD-STORED MEATS.

THE following matter is extracted from an article intitled "The Chemical Technology of the Frozen-meat Industry," in the *New Zealand Journal of Science and Technology*, by Mr. A. M. Wright, Chief Chemist to the New Zealand Refrigerating Company:—

The subject of moulds which have been found to develop upon refrigerated produce has been one of controversy, for, although there has been a belief that certain moulds can develop under cold-storage conditions, there has been doubt as to whether the growth of the moulds found upon cold-storage meats has not been due either to a breakdown of the plant or to defective insulation.

It has now been shown that the mould producing "black-spot," a *Cladesporium*, will grow and produce spores at least 5° C. below freezing-point (23° F.). This mould develops more rapidly if, before being placed in the cold, the meat with the spores is kept for about twenty-four hours at ordinary temperature, thus allowing the early stages of germination to take place under normal conditions. Growth is found to be very slow at low temperatures, but it is greatly enhanced if the temperature is raised to 0° C. (32° F.). So far the black-spot mould is the only one found to grow at a temperature considerably below 0° C., but several others develop fairly well at freezing-point. The black-spot fungus appears to be identical with the mould described by Dr. Klein many years ago and named *Cladesporium herbarium*.

Despite the fact that *Cladesporium herbarium* can grow at 23° F., the position should not prejudice the refrigerated produce, because it can only be possible for the mould in question to grow when the temperature is substantially above that usually maintained under cold-storage conditions, and it will scarcely be held that 23° F. is a usual or safe temperature at which to hold cold-storage products such as mutton or beef. Black-spot mould due to *Cladesporium herbarium* is frequently found in chilled beef. It is, however, a surface infection, and experiments carried out have shown that it is harmless to animals.

"Red-spot" upon meats has been found to be due to *Bacillus prodigiosus*; "brown-spot" upon chilled beef has been found to be due to a yeast; while another "black-spot" mould has been identified as *Oidium carnis*.

It is scarcely practicable commercially to altogether exclude from contact with the surface of meat the mould spores or bacteria which are almost universally present in the ordinary atmosphere. There are, however, certain precautions which have been found useful and which may be applied without incurring heavy expense. Dryness in the surroundings is to be sought, for damp encourages the growths; whilst moist coverings on the meat itself should especially be avoided. At intervals, when the chambers are cleansed the surfaces should be sterilized by vapour or spray of formaldehyde or sulphurous acid, and then dried by a current of air. The cloth coverings, either calico bags or "stockingette," should be effectually sterilized by heat. The maintenance of a temperature substantially below that at which the organism can grow is, of course, essential.

LAND FOR DISCHARGED SOLDIERS.

DURING the present month the following lands will be made available for discharged soldiers: In Hawke's Bay, fourteen sections in the Wharekaka Settlement, in areas ranging from 35 to 92 acres. These sections are very suitable for dairying. In the Wellington District, nine sections in the Almadale Settlement, in areas ranging from 35 to 149 acres, will be opened on 20th instant. These sections are also well adapted for dairying.

It has been previously mentioned in the *Journal* that there are a number of sections scattered throughout the Dominion still available for selection by discharged soldiers. The bulk of these sections, however, have been lying open and unselected for some considerable time, and the Government has therefore decided that the sections which are not immediately applied for are to be forthwith opened for application by the general public. Preference at the ballots will, of course, be given to any discharged soldiers who apply.

WHEAT-PRICES GUARANTEE FOR 1921-22 SEASON.

THE following notice was gazetted on 9th June, over the signature of the Minister of Agriculture :—

The Government has undertaken to purchase from wheat-growers all good milling-wheat of the 1921–22 season at the following prices :—

(*a.*) For Tuscan and similar varieties, 5s. 6d. per bushel f.o.b. ; for Hunters and similar varieties, 5s. 9d. per bushel f.o.b. ; for Pearl and similar varieties, 6s. 3d. per bushel f.o.b.

(*b.*) An increment of ¾d. per bushel per month will be added to above prices for wheat dealt with between 1st May, 1922, and 31st October, 1922.

(*c.*) Market rates will be paid if in excess of the above guaranteed minimum prices.

(*d.*) If it is necessary to determine market rates the Government will be guided by the following principle : In the event of any adjustment in prices being necessary the Government will be guided by the world's market value of wheat in February, 1922, of similar quality to New Zealand wheat, having regard to the necessary adjustment between North Island and South Island ; but in any case the purchase-price will not be less than the minimum stated above for the respective varieties with the monthly increment.

AUSTRALIAN EMBARGO ON NEW ZEALAND POTATOES.

WITH reference to the recent negotiations with the Commonwealth authorities in the direction of having the embargo on the importation of potatoes from New Zealand into Australia removed, a reply has been received from the Prime Minister of the Commonwealth, in which he states that it is much regretted that owing to the nature of "powdery scab" it is impracticable to indicate the requirements which would secure the Commonwealth against the introduction of the disease if the importation of potatoes from New Zealand were allowed. He adds that, in the interests of the potato-producing industry of Australia, the Government is unable to accept the risk of introducing the disease which the admission of potatoes from New Zealand into Australia would involve.

FORTHCOMING WINTER SHOWS.

Manawatu and West Coast A. and P. Association: Palmerston North, 21st, 22nd, 23rd, and 24th June (National Dairy Show).
South Taranaki Winter Show Company: Hawera, 5th, 6th, 7th, 8th, and 9th July,

(A. and P. Association secretaries are invited to supply dates and location of their shows.)

Wheat and Oats Threshings.—Returns of actual threshings received to 20th May by the Government Statistician from millowners showed that until then 5,508,770 bushels of wheat and 3,037,195 bushels of oats had been threshed out. The average yields per acre in cases where particulars of areas were furnished (covering 98 per cent. of total threshings) worked out at 32·96 bushels for wheat and 36·71 bushels for oats.

Carriage of Meat.—Paragraph 14 of Part I of the regulations under the Sale of Food and Drugs Act (relating to protection of food from contamination) has been amended by the insertion of the following additional clause : "No person shall send or deliver for carriage by any means whatever for sale any dressed carcase or portion of the dressed carcase of any sheep, cattle, or swine, or the carcase of any other animal, from which the natural covering has been removed, unless every part of that carcase is enclosed in a clean receptacle or cover so as to be maintained in a wholesome and clean condition."